UME 6 1930 NUMBER 3

# CONOMIC GEOGRAPHY

## JULY



ARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

# OUR CONTRIBUTORS

**Dr. Taylor,** professor of geography at the University of Chicago, contributes the last instalment of *Agricultural Regions of Australia*, a part of the series on the *Agricultural Regions of the World* published by ECONOMIC GEOGRAPHY. A geographer of note, he is familiar with various phases of geography of Australia. From 1920 to 1928 Dr. Taylor was head of the department of geography at the University of Sydney, and during 1927 and 1928 he was president of the Geographical Society of New South Wales. Dr. Taylor has written a great number of books on geography and related subjects, one of which, "Environment and Race," was reviewed in a previous issue of ECONOMIC GEOGRAPHY.

**Dr. Case,** now associate professor of geography at the University of Cincinnati, spent the summers of 1922–1924 with the Tennessee State Geological Survey. In 1925 he received his Ph.D. degree at the University of Chicago, and was connected with the Resource Survey of the University of Cincinnati from 1925–1927. He has written several papers including "Relationship of Industry to Environment in the Valley of Eastern Tennessee" for the Tennessee State Geological Department at Nashville, and "Forests and Forest Industries of Marine Regions" which appeared in the Bulletin of the Geographic Society of Philadelphia, July, 1929, issue, pages 213–234.

**Dr. Bauer,** who is at present associate in geography at the University of Washington, is a graduate of the University of Munich. He has done graduate work at the University of Greifswald and the University of Washington, having received both the M.S. and Ph.D. degrees from the latter university. Mr. Bauer has written a series of geographic articles on "Human and Economic Geography of the United States," published by the Bavarian newspaper syndicate, "Bayrischer Zeitungsblock" in Munich.

**Dr. Baker,** senior agricultural economist with the U. S. Department of Agriculture, contributes Part VIII of the series of articles on the "Agricultural Regions of North America." He has been in charge of the preparation of the *Atlas of American Agriculture*, and in 1923 was chairman of the Yearbook Committee of the Department of Agriculture. He is the author of several agricultural bulletins, and joint author, with Dr. V. C. Finch, of the "Geography of the World's Agriculture." His publications relative to agricultural resources and their utilization have appeared in the agricultural yearbooks, in the *Annals of the Association of American Geographers*, in the *Geographical Review*, and ECONOMIC GEOGRAPHY.

**Miss Poggi** is instructor in geography at the University of Illinois where she took her M.A. degree in 1928. She hopes to receive her Ph.D. degree in June, 1931. She trained in geography at the London School of Economics, University of London. Her paper in this issue is the result of personal field work, as was also her article on the "Red Land of Gwent" in a previous issue.



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## PLATEAUS

THE plateaus of the world have played a prominent rôle in the evolution of human culture. Whether or no they constitute the cradle of the human race, they certainly have formed one of man's chief training-schools where he learned to defend himself from the brutes who would have made him their prey and from the forces of nature that buffeted him from day to day or from season to season. They have given him the impetus to individualism within the social or community group and lent him the inspiration of their altitudes and wide horizons for monotheistic, idealistic religion. They have forced upon him thrift and frugality, courage and independence.

In the history of the races that bear highest the torches of modern civilizations, it is the Eurasian plateaus that impressed upon the character and culture of the Caucasian and Mongolian races the indelible stamp of their rigorous winters, their glorious summers; their pastoral valleys, their forested slopes; their advantageous points of view, their illimitable horizons. How deep is the imprint upon the ancient foundations of the oriental and occidental peoples of Asia and Europe of the stern and inexorable snows, the verdant grasslands, the stony piedmont paths of the Pamirs, the Caucasus, the Carpathians, and the Alps!

And wherever these peoples have emigrated to America, to Africa, to Australia, the plateaus play the same powerful rôle, whether it be in the Laurentian or Appalachian uplands of eastern North America; the Andean heights of South America; the table-lands of Rhodesia, Uganda, or Kenya in Africa; the high flats of eastern Australia. Economically, politically, culturally they have shaped the destinies of the future.

ECONOMIC GEOGRAPHY

VOL. 6 JULY, 1930 No. 3

# AGRICULTURAL REGIONS OF AUSTRALIA*

INSTALMENT II

*Griffith Taylor*
Professor of Geography, University of Chicago

## SOILS

VERY little work of a comprehensive nature has been done upon the soils of Australia, except in New South Wales, where several chemists (notably Jensen and Guthrie) have described many varieties (Fig. 29). The following account is based largely on the book (1914) by the former. Jensen describes the soils in terms of Tulaikov's classes as follows:

| *Tulaikov* | *Jensen's Name* | *Locality* | *Uses* |
|---|---|---|---|
| 1. Laterite soils | Red basalt soils (scrub-lands) | Northern coastal rivers Eastern slopes | Dairying, roots, fodder |
| 2. Loess | Red soils | Nyngan and red western plains | Wheat belt (white box and buddah) |
| 3. Dry steppe (alkaline) | Saltbush country | Cobar, Bourke, and West | Arid pastoral (saltbush) |
| 4. Tchernozem (lime and humus) | Black soil plains | West slopes and plains | Agriculture, maize, pasture |
| 5. Forest steppe (gray and leached) | Eucalyptus forest lands | Coast and tablelands | Fruit and farming |
| 6. Podzol (peats and organic acids) | Drained swamps | Coasts and tablelands | Pasture, crops, when drained |
| 7. Fenland | Cold tableland | Kosciusko | Summer pasture |

The north-coast soils are a fine series. The basalt soils are very similar to the leached soils of Madagascar and India.

The region around Sydney is a hungry Triassic sandstone which produces very poor soil. Behind Newcastle the Hunter River flats are built up of a rich soil as the river passes over a diverse series of rocks. The south-coast soils are better than those of the southern tablelands for large areas of basalt occur, while the granites are less siliceous on the coast. The South-West Slopes are also superior, since the soils are less leached and the granites richer in useful salts than those of the Southern Tableland. The latter, however, has an area of basalts in the Monaro region.

As regards the three tablelands (north, center, and south) the soil improves to the north, because the granites become more basic. Limestones abound in the western flanks, which produce good soil. The north is moister and warmer, and so similar soils (*e.g.* basalt) produce better crops in the north than in the south of the highlands.

All the western soils are richer in plant food than the others, since leaching is reduced to a minimum. But many types have such an accumulation of salts that they become alkaline. They consist of three classes: (1) good black soils, (2) fair red soils, and (3) poor light gray soils.

* The author wishes to correct two slight errors in Instalment I. Page 109, rainfall table, South America, should read "Largely *hot;*" page 126, Tasmanian map, "uninhabited land" contains a few small mining towns.

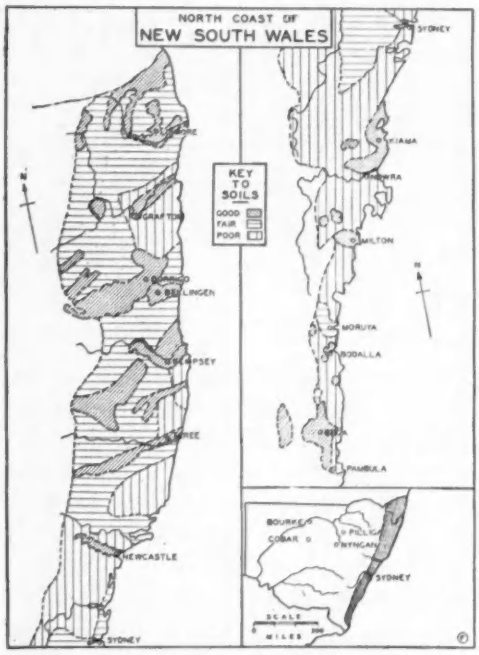



FIGURE 29.—Little work has been done upon the soils of Australia except in New South Wales, where H. I. Jensen has described and mapped the soils according to Tulaikov's classification as indicated in part on this map, and in the accompanying table. The south coast is also shown here.

*The Black Soil Plains* are widespread near the northern rivers (Gwydir, Namoi, etc.) flowing into the Darling. They are generally of basaltic derivation and are very sticky when wet. Organic matter in the alluvials amount to 7 per cent. They are poor in nitrogen and humus as compared with Russian black soils, but in phosphoric acid are among the best in the world. They are uniformly deep.

*The Red Soil Plains* are very variable. The best are on hilly country and are derived from basalt under oxidizing conditions. All rocks in the west which are not very poor in iron (and not situated in a *basin*) yield red soils, for the paucity of organic matter allows for a rapid oxidation of the iron in the clay. This accounts for the great extent of the Red Soil Plain. Such soils are abundant in the Riverina, where, however, they are derived from Tertiary rocks of a calcareous or shaly composition.

The associated trees are given in the table below (also from Jensen).

### MURRUMBIDGEE IRRIGATION AREA

In much the same environment as that of the western irrigation areas of

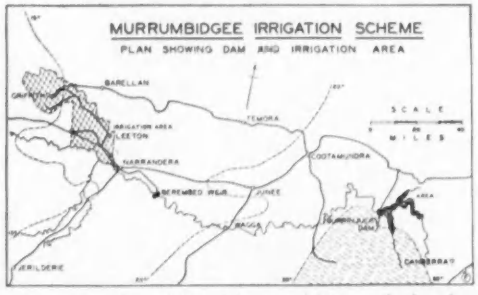



FIGURE 30.—The Murrumbidgee Irrigation Project is the most ambitious thus far completed in Australia. (Based on map by the Dept. of Lands, Sydney.)

the United States, a group of similar projects has developed in Australia. The rainfall falls off rapidly to the

| *Soil* | *Locality* | *Timber, Etc.* |
|---|---|---|
| 1. Hawkesbury sandstones | Sydney | *Eucalyptus eugeniodes, E. corymbosa, E. saligna, E. pilularis, Casuarina sp., Angophora, Acacia suavolens.* |
| 2. Wianamatta shale | Sydney | *E. hemiphloia, E. crebra, Melaleuca, Acacia decurrens, Syncarpia* or a mixture of 1 and 2. |
| 3. Rich volcanic soil | North Coast | *Cedrela, Araucaria, Doryphora, Tristania.* |
| 4. Poor western sands | Pilliga | *Callitris calcarata, Casuarina glauca, E. haemostoma.* |
| 5. Black soil plains | Northwest Slopes | *Acacia pendula, E. Woolsiana, E. melanophloia.* |
| 6. Heavy red soils | Nyngan<br>Riverina | *Geijera, Acacia homalophylla, Casuarina.*<br>*A. Cambagei.* |
| 7. Poor red soils | Cobar<br>Darling Basin | *E. populifolia, Eremophila, Dodonea.*<br>*E. intertexta, Acacia aneura.* |

FIGURE 31.—One of the numerous irrigation canals in South Australia, diverting water from the River Murray. (Courtesy of South Australian Govt., Intelligence and Tourist Bureau.)

west (see Fig. 30), and it is only possible to obtain large crops by supplementing the rainfall. The largest completed scheme impounds the water of the Murrumbidgee—but the Hume dam near Albury on the larger stream of the Murray will exceed it in importance.

The amount of land in the western plains suitable for irrigation is immense, but the scanty water supply in the rivers limits irrigation to a few favored localities. Near Yanco it is proposed to irrigate 250,000 acres ultimately by means of the large dam at Burrinjuck some 300 miles up stream from Yanco. Here, a deep gorge in the block-mountain region lends itself to such a structure.

The Burrinjuck Dam impounds about 13,000 acres,[9] and sends the water back up the river for 40 miles. The water passes through sluices into the river bed and so reaches Berembed weir, some 240 miles away in the plains country. The weir diverts the water to the north and a canal of 40 miles takes it to the irrigation area at Yanco. The first settlers arrived in 1911, but the war hindered progress. However, several thousands of farmers are now flourishing in a region which formerly only carried sheep; and it is hoped that the total population may ultimately reach 100,000. Nearly every kind of temperate and semi-tropical fruit grows most luxuriantly —apples, peaches, oranges, almonds, figs, as well as all kinds of grapes. Rice, cotton, tobacco, and peanuts promise well. All kinds of cereals flourish, but lucerne (alfalfa) has not done well so far.

Ten to twenty acres is the usual size of a fruit farm and 50 to 100 acres for dairying and mixed farming. Butter, bacon, cheese, and fruit-canning factories are established, and small towns have sprung up over the area. Leeton in the southeast, and Griffith in the north are the chief centers, the latter being perhaps the most progressive. These are linked to the east by two railway lines.

FIGURE 32.—In the utilization of the underground water supply, the equipment for raising the water has undergone an interesting evolution from the windlass well in the foreground, to the "horse whip" in the background, to the government windmill. Taken near Kingoonya, South Australia, in a region of 9-inch rainfall; by the author.

### IRRIGATION IN VICTORIA

In 1887 Chaffey Brothers installed pumps at Mildura on the Murray with which they irrigated 12,000 acres, and this method of water supply has been adopted at a number of small settlements along the lower Murray, especially in South Austra-

[9] Based on an account by Professor R. D. Watt (Pan Pacific Science Congress, 1923).

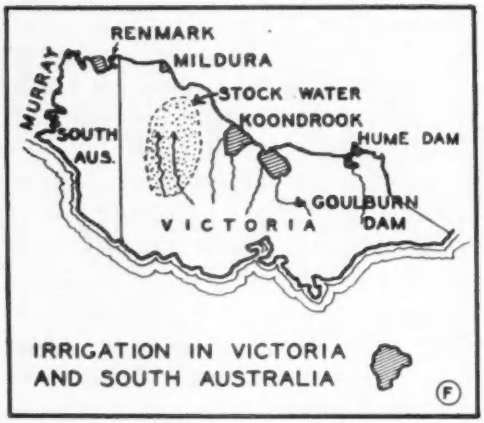



FIGURE 33.—Irrigation in Victoria and South Australia is an important factor in the advancement of agriculture and settlement.

lia. Occasionally in droughts as in 1902 and 1922, the big river ceases to flow and to prevent such occurrences a large dam is being erected above Albury where the Mitta Mitta River joins the Murray. The Hume Dam will store over one million acre-feet and there are being constructed by the Commission about 35 weirs and locks on the lower Murray and Murrumbidgee.

The chief irrigation in Victoria, however, depends on water obtained from the Goulburn River which rises in the highlands in the east of the State (Fig. 33). Small supplies are also obtained from the Campaspe and Loddon Rivers. A weir crosses the Goulburn at Nagambie, and a reservoir has been built near its headquarters. By this means water is carried east to augment the lower Broken River and west to the Waranga Basin and to augment the Campaspe and Loddon Rivers. During 1923–1924 the total area irrigated in Victoria was 324,558 acres, of which 94,479 acres were under alfalfa, 96,887 acres for cereals, and 64,647 for gardens.

There are two large irrigated districts thus served. The western area extends for about 50 miles south of Koondrook and includes the towns of Kerang and Cohuna. The eastern district extends for about 50 miles to the southeast of Echuca.

In addition to the land irrigated by these schemes there are large areas in the drier Wimmera and Mallee districts which are supplied for domestic purposes, and stock use, with water carried by long channels from small reservoirs at the head of the Wimmera and other western rivers. No less than 14 million acres were benefited in this fashion in 1923.

It is worthy of note that this environment corresponds fairly well to that served by irrigation in the

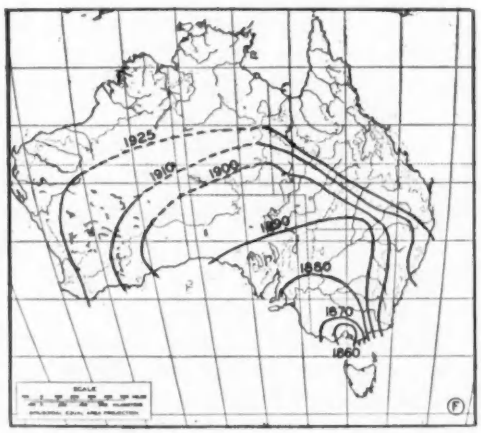



FIGURE 34.—The spread of the rabbit pest over Australia was relatively fast and apparently irresistible. Most of the continent is now infested. Isopleths correspond to wave fronts at dates specified.

United States. As there, the annual rainfall is between 10 and 20 inches. Neither country can teach us how to solve the problem of opening up arid Central Australia.

### DISTRIBUTION OF AGRICULTURAL PESTS

Since the latter part of the eighteenth century Australia has been menaced with agricultural pests.

### RABBITS[10]

Some rabbits were carried to Australia in the ships of the "First Fleet," for in 1788 they are recorded at Sydney (Fig. 34). In 1859 twenty-four were brought to Geelong in Victoria and about 1863 a large warren was established near Castlemaine, Victoria. When the fence at the latter site was destroyed by fire, the rabbits escaped and overran the central and western districts of Victoria. About 1880 the first long fence was constructed in the northwest of Victoria, and in 1887 a longer fence against rabbits and wild dogs was built between Victoria and South Australia. But, it was found almost impossible to supervise these fences, and to prevent fires destroying them, and the rabbits soon spread as far west as the Murray River in South Australia.

In South Australia they seem to have spread independently from Adelaide to Peterborough and Renmark by 1881. They reached Beltana by 1886 and Fowler's Bay and Lake Eyre by 1891.

In New South Wales the menace was well developed by about 1883, and in the next five years nearly one million pounds was spent to counteract them. Thus, the rabbits reached Tilpa (near Bourke) in 1882 and Coonamble in 1898. In 1887–1888 a fence was built across the State from Bourke to Corowa, and in 1890 another fence 648 miles long was erected between New South Wales and Queensland. This latter costs £11,000 per year to maintain. Soon, however, the rabbits crossed into Queensland.

[10] Data were gathered from various State Departments of Stock, to whom the writer's thanks are due. Only in Queensland, however, does information appear to have been systematically recorded.

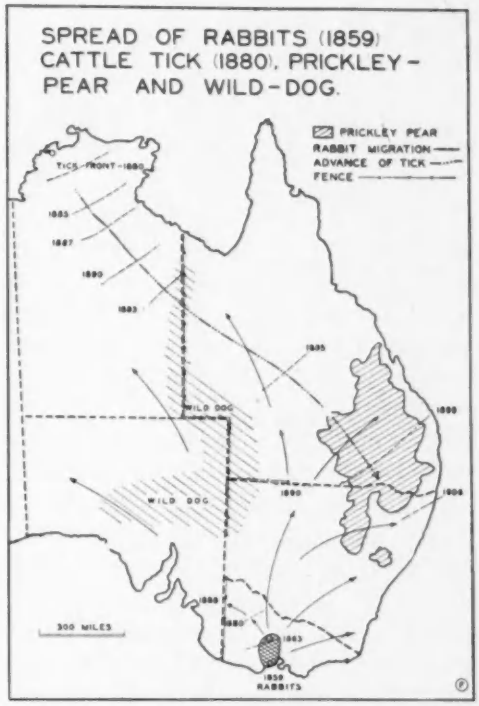



FIGURE 35.—The spread of rabbits introduced in 1859, the cattle tick introduced in 1880, the prickly pear, and the wild dog have materially added to the handicap the Australian settler has had to overcome.

In 1886 they had penetrated 30 miles into South Queensland. In 1895 there were many at Thargomindah, and in 1899 they reached Charleville. In 1906 they were seen near Camooweal. In 1922 they reached Longreach, but they are still largely confined to the south and southwest of Queensland. A tremendous network of fences characterizes Southern Queensland.

West Australia was the last State to become infested, for the wide desert stretch isolates it from the rest of Australia everywhere except in the north. Two great fences were erected. One runs from near Geraldton to Yalgoo and thence south to near Albany. It was built in 1904 and 1905. The larger runs from Condon on the northwest coast to

Hopetown 150 miles east of Albany. This is a distance of over 1,000 miles and was built from 1902 to 1907. Rabbits were first noted at Kalgoorlie in 1901, at Peakhill in 1913, York 1916, and Albany 1918.

The writer recently motored along this fence in the heart of West Australia, and found that it was not of great value, for the rabbits had passed from the desert westward into the huge unfenced "stations" (ranches). Since about ten rabbits eat as much as a sheep, the damage done by the rodents can be imagined. Upon three stations in New South Wales (aggregating one million acres) the carrying capacity between 1880 and 1890 was reduced by 120,000 sheep. But, with poisoning, trapping, digging-out, and closer fencing, the rabbit menace is gradually becoming controlled in the chief pastoral districts of Australia.

### WILD DOG

In the last decade or so the pastoralist on the borders of the desert country has been greatly troubled by the dingo and by crosses between the dingo and the larger forms of European dogs. Netted fences similar to those to keep out rabbits (but with larger mesh) have been erected between Queensland and the Territory; between Queensland and New South Wales, and between the northwest of New South Wales and South Australia. For a time the dingo lived on the rabbit, but by degrees drought and dog killed off most of the rabbits in the debatable land, and the dogs moved eastward into New South Wales and Western Queensland. Here they killed the lambs in thousands. It is reported that north of Broken Hill one station lost 22,000 sheep and another 45,000 sheep in one year. A bonus is paid for dingo scalps varying from £1 to £10 per scalp, and this menace is now decreasing. But the result has been a remarkable changing from sheep to cattle in much of the wild-dog area, indicated approximately in the diagram (Fig. 35).

### CATTLE TICK

This pest has caused grave losses in Northern Australia, especially during the period from 1894 to 1900, when cattle worth £3½ millions died. Many herds lost 90 per cent of their numbers. It started near Darwin in 1880 and by 1900 it had reached Brisbane, as shown in the diagram. By suitable dipping methods the ticks are eradicated, and so the "Texas Fever" (due to protozoan parasites transmitted by the tick) did not spread far south of the Queensland border. It is now, also, well under control in Queensland. From Darwin tick fever spread down the western cattle lands as far as Perth, but it has not caused such serious damage in that part of Australia as in Queensland.

### PRICKLY PEAR PEST

This is a growing menace in much of the best agricultural land of South Queensland. Over 30 million acres have been invaded (according to Professor Johnston), and it is increasing at the rate of 800,000 acres a year. Very promising experiments with insects, which prey upon the pear, have been carried out, but the problem cannot be described as satisfactorily solved.

## STUDIES OF SPECIAL CROPS

The distribution of the various crops in the six states has now been considered in some detail. It is use-


FIGURE 36.—The cultivation of sugar cane has become one of the profitable and promising industries of the tropical and subtropical east coast, where the rainfall exceeds 40 inches annually.

ful, however, to discuss the more interesting crops without reference to State boundaries. As regards importance wheat stands out, and it is treated most fully. Oats is only of considerable importance in Victoria and Tasmania. Its distribution is shown in Figures 18 and 19. Barley is important in South Australia and is charted approximately in Figure 20. A special map of maize (Fig. 40) with a description of the most suitable climate controls is given in the following section. It is surprising that the rich "black soils" of the western slopes of New South Wales are not more fully used for maize. The writer is told that the rainfall is too unreliable—and the soil "too sticky to work." No doubt the future will see these disabilities overcome.

Of the remaining less important crops, sugar is discussed because it illustrates tropical work by folk of British race. Cotton, again, is a newcomer, at any rate, on a large scale. The world is curious to see if it can be grown against outside competition. Finally, Tasmanian agriculture is rather different from that on the mainland—and the environment closely resembles that of north France or south England. It is briefly described. A short discussion of the pastoral industry closes this section.

### SUGAR REGIONS

The crop is confined to the well-watered east coast. The sugar is all derived from cane, apart from a little sugar-beet grown in Victoria (Maffra) (Fig. 36). The cane plantations extend down the East Queensland coast and just into New South Wales. The range of average annual temperature is very considerable, from 78° F. at Port Douglas to 68° F. at Grafton. The necessity for a rainfall exceeding 40 inches confines the plantations to the coast. The table on the following page shows the climatic controls.

In Queensland, sugar cane comprises one quarter of the agriculture of the State (about the same as maize) and is worth more than six millions sterling annually. There are 38 mills, the tendency being to shut down the small mills and build fewer but much larger mills.

The plantations are confined to the narrow belt between the highlands and the sea. Here are the constant trade winds, and numerous coastal cyclones give an abundance of rain. The most progressive region is that near Mourilyan, which has the highest annual rainfall in Australia (Harvey Creek, 165 inches). The plan-

FIGURE 37.—A typical central sugar mill near South Johnstone in North Queensland. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

tations are made in two types of country, the vine scrubs and the eucalypt forest. The former is a true Malayan tropical forest with many softwoods; the latter the more open type without vines, and containing much "bloodwood" (Eucalyptus sp.).

white farmers outside Queensland who work in latitude 16° at sea level with temperatures such as occur at Port Douglas (see table).

Cane cutting is done chiefly in June and the following cooler months. It is stated that the death rate is low, even among children. This district is

| *Latitude* (° S.) | *Locality* | *Approximate Temperature* (° F.) | *Annual Rainfall* (Inches) | *Cultivated 1923* (Acres) | *Order of Importance* |
|---|---|---|---|---|---|
| 16 | Douglas | 78 | 83 | 30,300 | 4 |
| 17 | Cairns | 76 | 90 | | |
| 17½ | Mourilyan | 76 | 159 | 48,900 | 2 |
| 18½ | Ingham | 76 | 80 | | |
| 19 | Townsville | 76 | 50 | 24,700 | 5 |
| 19½ | Ayr | 75 | 45 | | |
| 20½ | Proserpine | 75 | 42 | 6,300 | 7 |
| 21 | Mackay | 72 | 68 | 51,100 | 1 |
| 22 | St. Lawrence | 72 | 43 | 1,300 | 10 |
| 24 | Gladstone | 71 | 41 | 400 | 11 |
| 25 | Bundaberg | 70 | 41 | 48,500 | 3 |
| 26½ | Maroochy | 69 | 65 | 5,700 | 8 |
| 27½ | Logan | 69 | 32 | 1,300 | 9 |
| 29 (New South Wales) | Lismore | 68 | 70 | 14,000 | 6 |
| (New South Wales) | Maclean | 68 | 47 | | |

It is stated that the northern canes yield more sugar than the southern. Thus, in the Cairns district 8 tons of cane give 1 ton of sugar, while in the extreme south 10 tons are required. Intermediate regions vary correspondingly.

The industry is of great interest, as the white cane growers near Cairns are the advance guard of such agriculture in the tropics. For instance, the coastlands of Texas have a mean temperature like that of Bundaberg (70°), while Rio de Janeiro resembles Ayr, Queensland. I know of no

fortunate in having the Atherton tableland, 2,000 to 5,000 feet above the sea, immediately behind it, in which the coastal settlers should be able to recuperate. The rainfall is sufficient in most of the plantations, except in the Bundaberg and Ayr districts, where irrigation is resorted to.

Frost occasionally damages crops as far north as Bundaberg, while hurricanes have at times destroyed much cane in Mackay and Innisfall (as in 1918). H. T. Easterby gives a description of the various regions in a recent publication (Brisbane,

1924), from which the following notes are taken.

"Around Douglas the soil is nearly all alluvial, and both eucalyptus and tropical forests give place to sugar. In the Cairns district the sugar lands occur chiefly in the raised coastal plain along the lower Russell and lower Mulgrave Rivers. There are also large areas of volcanic soil. Similar lands are found near Innisfall. Here the average relative humidity (80 per cent) is probably the highest in Australia (as is the rainfall); which is good for the cane, but uncomfortable for white folk.

"In the Mackay district there is the greatest number of cane-farmers, and almost all the best land is ploughed. A long stretch without any sugar-fields of note separates Mackay from Bundaberg. The latter town is well south of the tropics. The cane grows slower, and in times of drought, cutting may be deferred till next season. Ratoon sugar is more commonly grown here than in the north. Maryborough has changed from cane to dairying, and there is only one mill in place of 15. The same transfer has occurred in most of the sugar areas in the south of the State."

In New South Wales the sugar crop is less than one-half per cent of the total crops. It has gradually been driven north by fear of frost and is now confined to the Grafton-Lismore region in the extreme north. Even here, dairying is displacing sugar, so that the crop now is only one-third of what it was in 1895. There are only three mills in the region.

### COTTON REGION

Queensland is the only State where cotton is grown in any noteworthy degree. As far as climate is concerned, it is possible to grow cotton almost anywhere north of Sydney where the rainfall exceeds say 25 inches. The homoclime (similar climate) of the great American cotton area runs along the east coast of Australia from Sydney to Brisbane, but no cotton of note is grown here


FIGURE 38.—The cotton production of Queensland, though not yet appreciably significant in the world's markets, will possibly expand until it becomes a real factor in the world supply.

yet. The homoclime of Berar (the great Indian region) extends around the north coast from Townsville to Derby (West Australia). But this coast has a marked winter drought, and here again no commercial cotton has as yet been grown. In the intervening region from Brisbane to Rockhampton a relatively large area has recently been planted—and will no doubt expand greatly.

| *Year* | *Area in Acres* | *Yield in Pounds* |
|---|---|---|
| 1919 | 72 | 27,470 |
| 1921 | 1,944 | 940,126 |
| 1923 | 40,821 | 12,543,770 |
| 1925 | .... | 24,000,000 |

The map of the distribution of cotton in 1923 (see Fig. 38) is in no sense a complete one. The cultivated areas are scattered at considerable intervals. However, it is possible to see where the various agricultural centers are going in most extensively for cotton. It is clear that the Rockhampton region is the chief, for near this town there are

FIGURE 39.—Cotton may be successfully produced on a limited scale as demonstrated at Wowan, near Rockhampton. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

14,000 acres under cotton, and nearby at Wowan 90,000. We may consider this region as the chief center of cotton.

The second isopleth (denoting moderate interest in cotton) also includes Gladstone in the north. But there is a larger area of about this standard along the southern railway from near Toowoomba to Roma. Thus, of equal importance with Gladstone are the Darling Downs (near Toowoomba), Roma, and Gayndah to the north.

The outer limit of cotton gives us the third isopleth. It extends from Rockhampton to Clermont, thence to Mitchell and so south to the border at Goondiwindi. Within this boundary in 1923 were about 75,000 acres, of which about 41,000 were bearing, and 34,000 not bearing. Only 400 acres were to be found in the rest of Queensland.

It is clear that the cotton is grown in regions a good deal drier than those used in the chief centers of the world's supply (*e.g.* United States or India). It is difficult to imagine that such dry places as Emerald, Springsure, and Goondiwindi can rival the better lands near the coast. The latter are largely devoted to sugar, but probably in the future cotton will move toward the wetter regions and perhaps displace sugar to some extent. Uruguay, South China, and Natal are homoclimes of this agricultural region. As shown in the section on sugar, the average temperature at Rockhampton is about 72° F., and at Brisbane about 69° F. The inland towns, Wowan and Toowoomba, are elevated about 1,500 feet, and are correspondingly cooler.

### MAIZE

Although maize is one of the most important cereal crops in the world, it does not bulk largely in Australia, constituting only 2 per cent of the total agricultural produce. This is the more surprising, because much of southeast Australia is a homoclime of the "corn-belt" of the United States. However, it is confined almost entirely to the two States of New South Wales and Queensland (see Fig. 40).

In 1923 and 1924 the maize data were as follows:

| | *1923–1924* | *1924–1925* |
|---|---|---|
| New South Wales | | |
| Acres | 166,933 | 146,564 |
| Bushels | 4,621,950 | 4,208,200 |
| Queensland | | |
| Acres | 120,092 | 229,160 |
| Bushels | 2,024,902 | 7,330,821 |
| Total Australia | | |
| Acres | 316,309 | 398,949 |
| Bushels | 8,114,733 | 12,432,037 |

Over 90 per cent is grown for the grain, but a good deal serves as green forage in dairies. The total amount has fallen off since 1910–1911. The average yield per acre is about 25 bushels.

Reference to the map shows that the optimum conditions occur to the

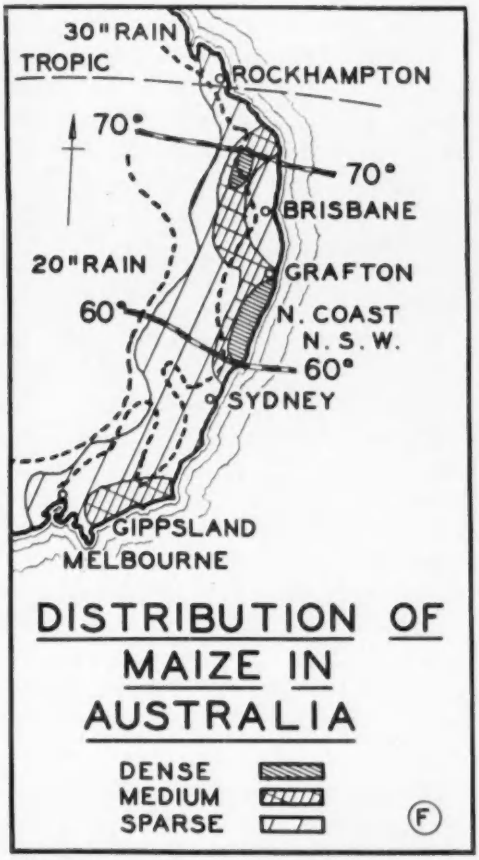



FIGURE 40.—Maize does not bulk large in the agriculture of Australia, constituting only 2 per cent of the total agricultural produce. Optimum conditions for its production pertain northwest and south of Brisbane.

northwest and south of Brisbane. Here the rainfall is from 30 to 35 inches per annum, and the average temperature from 65° F. to 70° F. A much colder locality with some maize occurs in Gippsland, Victoria.

## WHEAT [11]

This crop is by far the most important in the Commonwealth and constitutes 63 per cent of the area cultivated. Only in Queensland in 1924–1925 (18 per cent) and Tasmania (5 per cent) has it a subordinate position. The production and climatic controls in the several States are given below.

The primary control is the rainfall, but it is not the total precipitation so much as the amount which falls during the growing period (April to October) which determines the wheat belt (Fig. 41).

The Commonwealth Meteorologist gives the following areas as suitable in climate for wheat, and the author has added the areas actually cultivated in the second column.

| *State* | *Over 10 inches* (Square miles) | *Approximate Area* (Square miles) |
|---|---|---|
| New South Wales | 163,772 | 5,000 |
| West Australia | 93,500 | 2,000 |
| Queensland | 79,247 | 230 |
| Victoria | 74,616 | 4,200 |
| South Australia | 46,980 | 3,700 |
| Tasmania | 26,215 | 340 |
| | 484,330 | 15,470 |

There are obviously vast areas suitable for wheat, which have not been developed. The first column, however, makes no allowance for rugged and barren regions which naturally constitute an important

WHEAT 1923–1924 AND 1924–1925
Period—July to June

| | *Bushels* 1923–1924 | *Bushels* 1924–1925 | *Temperature—April-October* Whole Region | *Temperature—April-October* Optimum Region | *Rainfall—April-October* Whole Region | *Rainfall—April-October* Optimum Region |
|---|---|---|---|---|---|---|
| New South Wales | 33,171,000 | 59,752,000 | 61° to 52° | 61° to 52° | 25° to 9° | 15° to 11° |
| Victoria | 37,795,000 | 47,364,000 | 55° to 52° | 55° to 52° | 25° to 8° | 15° to 10° |
| South Australia | 34,551,000 | 30,528,000 | 58° to 54° | 57° to 55° | 25° to 6° | 20° to 10° |
| West Australia | 18,920,000 | 23,887,000 | 63° to 57° | 62° to 57° | 30° to 10° | 20° to 15° |
| Queensland | 243,000 | 2,779,000 | 62° to 60° | ..... | 20° to 10° | ..... |
| Tasmania | 305,000 | 231,000 | 52° to 46° | ..... | 40° to 10° | 20° to 15° |
| | 124,985,000 | 164,541,000 | | | | |

[11] This account is based on a paper read before the Royal Meteorological Society of London in 1920.

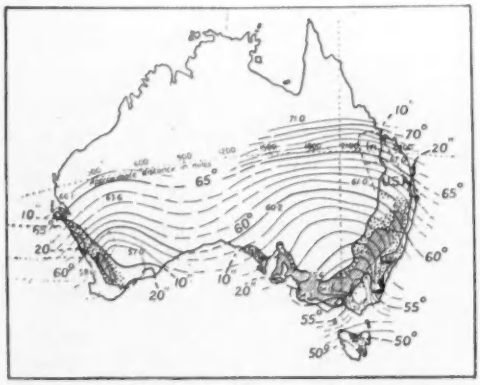


FIGURE 41.—The climatic control of wheat production. (The 10-inch and 20-inch winter rainfall [April–October] is based on H. A. Hunt.) The average temperature during the same period is given. Regions of heavy wheat production are ruled; of light production are dotted. Analogues with Indian and U. S. A. wheat fields are indicated in Queensland. (From the author's "Australian Meteorology.")

portion of our wetter littoral, since this includes almost all the highlands.

In the early stages of wheat-growing in Australia mistakes were made and progress was slow. Cultivation was confined to the moist coastal country with its annual rainfall of 30 to 40 inches, and wheat was not a success (see Fig. 17). The discovery that the drier districts inland were more suitable for wheat growing altered the position very greatly. The bulk of the wheat is now grown in districts with a rainfall of 25 inches and under. On well-worked fallowed land it is stated that splendid crops have been gathered, although the growing crop only had two or three inches of rain.[12]

In Australian wheat districts the quantity of rain is not as important as the time of the year in which it falls. Rain is wanted in the early autumn so that ploughing can be done, and in the spring when the wheat is heading and flowering. With rain in April and May, and again in September or October, the Australian is assured of a fine crop. The summer is usually dry and warm, and this is one of the main advantages. Unless the common rule is broken and the season is unduly wet, there is no fear of rust, and nothing to interfere with the hay-making. The main crop, which is kept for grain, can be left standing safely in the paddocks until it is thoroughly ripe, when it is taken off with a stripper or

FIGURE 42.—Wheat in shock on Roe's Farm, Northam, West Australia, in one of the richest wheat belts in the Commonwealth. (Courtesy of West Australian Govt.)

[12] "Wheat-growing in Australia," Melbourne, 1915.

FIGURE 43.—Harvesting wheat on a grand scale at Hallett in the midnorthern agricultural area, South Australia. (Courtesy of South Australian Govt., Intelligence and Tourist Bureau.)

harvester and bagged. Thus, the districts that have the heavy summer rain are largely unsuitable for wheat-growing.

If reference be made to the rain reliability map (Fig. 3), it will be seen that conditions in this respect are best in Swanland (West Australia), and worst in the north of New South Wales. The former has the rainfall in winter, the best season, and though the total is low, it is reliable. The latter has most of the rain in summer, and it is also distinctly unreliable.

In most of the wheat areas the crop depends very largely on the rainfall stored in the soil from the previous year. The actual rainfall during growth may be only 7 inches or even less, but this is supplemented by the fall while the land was fallow.

In New South Wales the practice is

FIGURE 44.—Wheat arriving for shipment in the railway yards in Laidley, southeast Queensland. A steady procession of farmers' wagons converges upon the town at the height of the harvest season. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

to plough the land in July or August, to a depth of from 4½ to 5 inches, and then to let it lie for six weeks, after which it is harrowed. Subsequently the fallow receives frequent workings with the cultivator, so as to form a loose mulch which checks evaporation. This operation is repeated (until sowing time in April or May) whenever a hard crust is formed. The majority of districts enjoy an annual rainfall of 20 inches or less, and it not infrequently happens that only from 6 to 8 inches of this falls during the growing period, which is quite adequate to produce a crop of wheat of, say, 20 bushels.

In New South Wales the most productive region is the Riverina around Corowa, and thence north to Molong. The county of Hume as a whole produces 1,800 bushels per square mile, and is probably the most productive center for Australia. The relation between the wheat isopleths and the winter isopleths is extremely close. The 10-inch line is the western boundary of the wheat area except at one or two places. A rainfall of over 20 inches in the wheat period practically fixes the eastern boundary in this State, for only around Sydney is a little wheat grown in wetter districts. But, until the railways are much more numerous, there will be large areas of wheat-land unoccupied. The farthest distance from the railway to make wheat-growing profitable should not exceed 18 or 20 miles (see Fig. 17).

A revolution in wheat growing may be said to have taken place with the advent of "Federation" wheat and other new varieties produced by William Farrer. Such an extensive range is provided that farmers can now begin their sowing in the principal areas with one kind of wheat at the end of March, continue sowing through April, May, June, and finish with certain varieties at the end of July.[13] The early sown varieties ripen later, and so the harvest ripens in stages and can be more readily handled.

In Victoria the greatest area under cultivation lies in the north and northwest (see Fig. 18). The irrigation counties of Rodney and Moira are the most important (though the wheat is not often irrigated), but the adjoining Wimmera regions are nearly as important. These regions fall within the rainfall controls specified earlier. There are several outlying regions of considerable interest in Victoria. Thus, around Sale is a small wheat district in the wet region of Gippsland, due to the low rainfall of a rain-shadow. In the same way the rain-shadow to the southwest of Melbourne includes the drier coastal counties which grow wheat. In the Victorian Mallee is a large extent of sandy loam country with a light winter rainfall from 10 to 15 inches. For a long period this land was deemed unfit for wheat, but experience has proved that it is quite profitable when properly worked. The land is, of course, worked on the three-year rotation system of fallow, wheat, grazing.

In South Australia there is a northward bulge in the isohyets caused by the Flinders Range and possibly influenced also by the long gulfs running 200 miles into the continent. Here six counties around St. Vincent Gulf each produced more than two million bushels for the season 1915–1916. The climate is ideal for wheat culture, nearly all the rain falling in winter. Hence, the production per

[13] Vide Ross "Wheat" in Handbook for New South Wales.

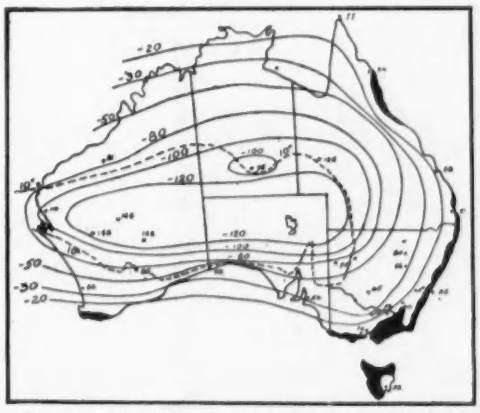


FIGURE 45.—Sketch map showing net rainfall (rainfall − evaporation). Small figures are inches evaporated per annum. Black areas are those where rainfall exceeds evaporation. (From the *London Meteorological Journal*, 1920.)

head of population is much greater in this State than any other. The county of Daly (around Wallaroo) produces nearly as much wheat (1,690 bushels) per square mile as Hume in the Riverina. The 6-inch winter rainfall line, which is about equivalent to the 10-inch annual isohyet, seems to mark the outer limit of wheat culture. This is considerably beyond "Goyder's Wheat Line," which was laid down in 1865 as a safe limit and was based on the native vegetation. The West Australian wheat belt is described elsewhere.

### DRY FARMING AND THE LIMITS OF THE WHEAT BELT

It is very difficult to determine the lowest limit of the rainfall which admits of profitable agriculture in Australia. In much of the wheat region only one-third of the area is under wheat at a time; and the dry farming methods of fallowing and careful tilth become increasingly important as the arid interior is approached.

Although the wheat belt lies in a region of winter rainfall (except in the northeast) there is no portion of Australia without an appreciable summer rainfall. Thus, even in the Northam region (West Australia) the five hottest months contribute 3 inches out of the total 17. Hence, the statement that "all the rain falls at the right season" is only relatively correct.

The definition of dry farming varies in the district concerned. Thus, in South Australia a region receiving less than 13 or 14 inches a year is so classed, but in northern New South Wales 22 inches or even 25 inches is "dry." In Victoria wheat is grown in the Mallee country between Ouyen and Pinneroo, with an average of 13 inches of rainfall.

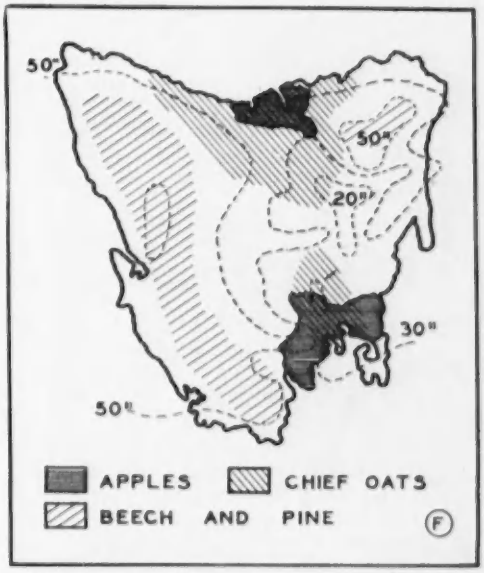



FIGURE 46.—The cool temperate climate of Tasmania favors the growth of the cereals, root-crops, fruits and vegetables upon which the white race depends for its food supply. Apples, potatoes, hops, and oats are among the leading crops. (From the *London Meteorological Journal*, 1920.)

A factor of vital importance in dry farming is the evaporation. In Australia (as in most parts of the world) only a few stations have records of this element, and some of the records in the west especially are obtained from small pans which are not satis-

factory. It has been stated that every 3 inches of evaporation demands 1 inch of extra rain as an offset, so that it is found that 15 inches of rain in the southwest of New South Wales is equivalent to 20 inches in the northwest.[14] The writer gives the net rainfall (rainfall minus evaporation), as nearly as the records will admit, in Figure 45. It is to be noted that a worked summer fallow accumulates 5½ to 7 inches more water (in the upper 6 feet) than similar soil growing a crop.[14]

The typical dry-farming region in South Australia for profitable wheat is the Mallee—of which Lameroo may be taken as a type. But, here 16 inches is the average. The land, however, was locally termed "desert" until about 1896. It consists of light, sandy ridges running east and west, which are about one-fourth mile wide. Dark loamy hollows alternate with the sand-ridges. Mallee scrub (6 to 15 feet high) covers most of the country. This is rolled down in June or July, and then burned. With the aid of superphosphates, crops of 13 bushels are not uncommon, though 8 has been the average to date (see Fig. 10).

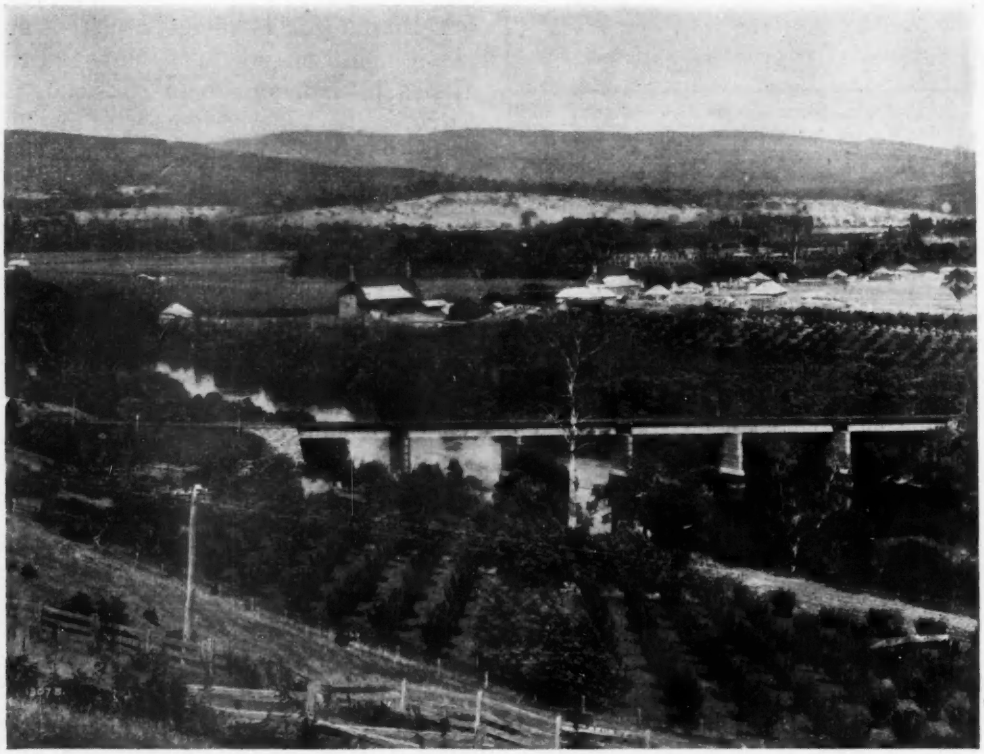


FIGURE 47.—The prosperous apple orchard districts of Tasmania constitute one of the most attractive landscapes of Australian agriculture. (Courtesy of Tasmanian Govt.)

The writer in his *Bulletin on Climatic Control*[15] showed that a close parallel existed between the conditions in East-Central Queensland (between Mackay and Charleville) and in Central India. At Jabalpur

[14] Anderson, Dry Farming Conference, Adelaide, 1911.

[15] Melbourne, Commonwealth Bureau of Meteorology, Bulletin No. 14, 1916.

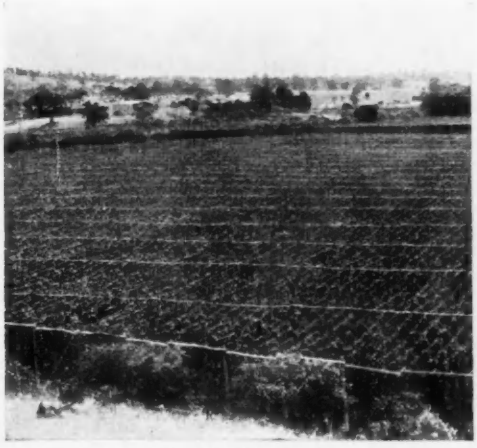


FIGURE 48.—A valuable yield of hops in Tasmania, not far from Hobart. (Courtesy of Tasmanian Govt.)

in India the temperatures are much higher than those of the Queensland wheat belt, yet great quantities of wheat are grown.

### TASMANIA—THE COOL TEMPERATE STATE

This elevated island lies 150 miles south of Victoria. Its area is 26,000 square miles, and its average temperature is near 52° F., about the same as that of the south of England. Thus, the climatic controls differ considerably from those of the Mainland. It lies almost permanently under the influence of the moist westerly winds (thus in part resembling southwest England). The high western part of Tasmania is too bleak and wet for settlement—a unique feature in hot arid Australia! A strip of highlands near Mount Lyell receives over 100 inches of rain a year (see Fig. 46). The population is confined almost wholly to the north and east, and there are two economic centers—Launceston and Hobart, the latter being the capital. The northern tract from Wynyard to Launceston is one of the most populous parts of Australia (see Fig. 46).

In spite of Tasmania's small area (less than 1 per cent of the Commonwealth) in such a crop as potatoes it ranks near Victoria, the leading State, while a much larger proportion of the population is engaged in orchards and hops than in any other of the States. Oats is the chief crop, there being, in 1923, 51,000 acres as opposed to 14,000 acres under wheat. The chief centers of production are along the north coast, and in the central north. Potatoes are a very important crop, there being 37,000 acres, chiefly in the northwest from Wynyard to Sheffield. The fruits grown in Tasmania include all those

FIGURE 49.—Potatoes in bloom, promising a heavy crop of tubers, on new land from which the original forest has but lately been removed. (Courtesy of Tasmanian Govt.)

of temperate climes, but apples are by far the most important. The area rivals that of Victoria comprising 25,000 acres. The chief apple center is to the south of Hobart, near Franklin, but a good many are grown around Launceston.

Timber is of considerable importance. Owing to the good rainfall the proportion of forest is greater than in any other State—for the whole except the Central Plateau is more or less covered. The trees are chiefly eucalypts in the east; but a different association, due to the very heavy rainfall is found in the west

FIGURE 50.—Tasmanian timber operations. Hauling out saw logs by steam donkey engines from the more heavily forested areas. (Courtesy of Tasmanian Govt.)

and in the Ben Lomond region in the northeast. Wherever the rain exceeds 50 inches yearly, the eucalypt is largely replaced by an evergreen beech (*Fagus Cunninghami*), and this same tree occurs in a similar habitat on the coast of Victoria. Moreover, there are small but valuable areas of softwood pines in the west. These areas are indicated in Figure 46.

## PASTORAL INDUSTRY IN AUSTRALIA

The brief discussion of the general environment of the continent has shown that Australia as a whole is better suited for pastoral than for agricultural industries. While the agricultural areas will some day expand considerably to the westward especially in Queensland and along the north coast, yet three-quarters of Australia is probably too dry and hot for profitable agriculture. On the other hand, hardly any of it is so dry that some stock may not be grazed upon it. While a very large area (65 per cent) receives less than 15 inches of rainfall a year, only a small proportion (about 7 per cent) receives less than 6 inches.

RAINFALL AREAS IN AUSTRALIA
(After H. A. Hunt)

| | *Square Miles* | *Percentage* |
|---|---|---|
| Under 10 inches | 1,067,357 | 36 |
| 10 to 15 inches | 603,605 | 20 |
| 15 to 20 inches | 358,458 | 12 |
| 20 to 30 inches | 534,766 | 18 |
| 30 to 40 inches | 213,195 | 7 |
| over 40 inches | 194,423 | 7 |
| Total | 2,971,804 | 100 |

It is this large proportion of arid Australia with a rainfall over 6 inches, which accounts for the almost total absence of shifting sand-dunes. Very large areas, however, are now covered with fixed dunes, so that apparently central Australia was even drier in the not very remote geological past; though the cycle immediately preceding the present one would seem to have been much wetter than at present.[16]

The stock of Australia grew fairly rapidly in numbers from 1860 to 1890 (see Fig. 51), then diminished rapidly to 1902, since when they have climbed again to much the same figure as in 1890. This is shown clearly in the accompanying graph (from the *Commonwealth Year Book*), where the heavy black lines indicate the years of drought. It was the great drought of 1902 which put an end to the overstocking which had existed about 1890. But rabbits and other pests have also in part accounted for the slow increase since 1890.

[16] This aspect of the paleogeography of Australia is fully discussed in the writer's recent book "Environment and Race," Oxford, 1927.

The total numbers of stock in the different States are given in the table below.

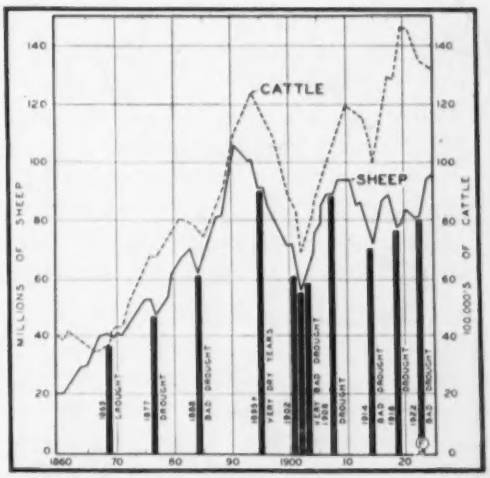



FIGURE 51.—That there is a close relation between the prosperity of the livestock industry and the annual precipitation, this chart leaves no doubt for Australia. Rabbits and other pests have also played a part. (From Commonwealth Year Book.)

### CATTLE

As regards cattle we can divide the total into dairy cattle and beef cattle. Very different environments determine the range of these two types. The dairy cattle are naturally found where pasture is rich, which confines them practically to the well-watered east coast of Australia, or to the rare irrigation regions. Furthermore, proximity to large towns has until lately been an important factor as regards the dairy industry. This is, however, becoming of less importance as better means of communication and more and more refrigerating plants and butter factories are established (see Fig. 52).

The densest distribution of cattle is perhaps found in Victoria, where the cooler climate and good rainfall are particularly suitable for milk production. The north coast of New South Wales and the adjacent coastline of Queensland (around Brisbane) are equally important dairy regions. These two latter areas are those where the chief maize crop of Australia is grown (see Fig. 53).

The second grade of cattle distribution is found associated with dairies near less important cities with good pasture such as Launceston and Hobart in Tasmania, or near large cities with a dry climate such as Adelaide and Perth.

The third grade occurs in the Tropics along a belt from Townsville, Queensland, to Broome, West Australia. This is a belt of Savannah or prairie country with a well-marked summer rainfall. It is too dry to grow forests, and indeed forms part of the prairie belt which everywhere fringes the desert belts of the world. To the north the grasses become too rank, and in the opinion of some authorities, they are here less nutritious than similar grasses in drier localities.

Certain halophytes (like saltbush,

| | *Number of Cattle* | *Per Cent* | *Number of Sheep* | *Per Cent* |
|---|---|---|---|---|
| New South Wales | 2,932,437 | 22 | 37,539,413 | 47 |
| Victoria | 1,591,367 | 12 | 11,059,761 | 14 |
| Queensland | 6,396,514 | 48 | 16,756,101 | 21 |
| South Australia | 413,272 | 3 | 6,596,875 | 8 |
| West Australia | 953,764 | 7 | 6,595,867 | 8 |
| Tasmania | 220,351 | 2 | 1,557,716 | 2 |
| Northern Territory* | 843,718 | 6 | 6,914 | .. |
| Total | 13,351,423 | 100 | 80,112,647 | 100 |

* Northern Territory was subdivided in 1926 along latitude 20° S. into Northern and Central Australia. The division has little economic significance.

*Atriplex*) are valuable fodder-plants found on the southern edge of this great cattle belt. It comprises the Fitzroy Valley in the west, the Victoria river area and Barkly Tableland in Northern Territory and the Northern "Downs" of Queensland.

The remainder of Australia from the point of view of cattle distribution is divided into two grades. There is a large area in the west where there are no cattle—and indeed only a few sheep on the southern edge. This is mostly so arid, that it has not yet attracted pastoralists. The intervening regions labelled *Sparse* and *Fair* in the adjoining map (Fig. 53) are the chief habitats of sheep. Since the latter pay better than cattle (other things being equal) there is no great area given over to cattle in the drier regions in Australia, south of the Tropic. It is to be noted, however, that in the heart of Australia (in the Macdonnells), and to an increasing degree on the edge of the "Never Never" (as the absolute fringe of settlement is called), cattle and not sheep are usually pastured.

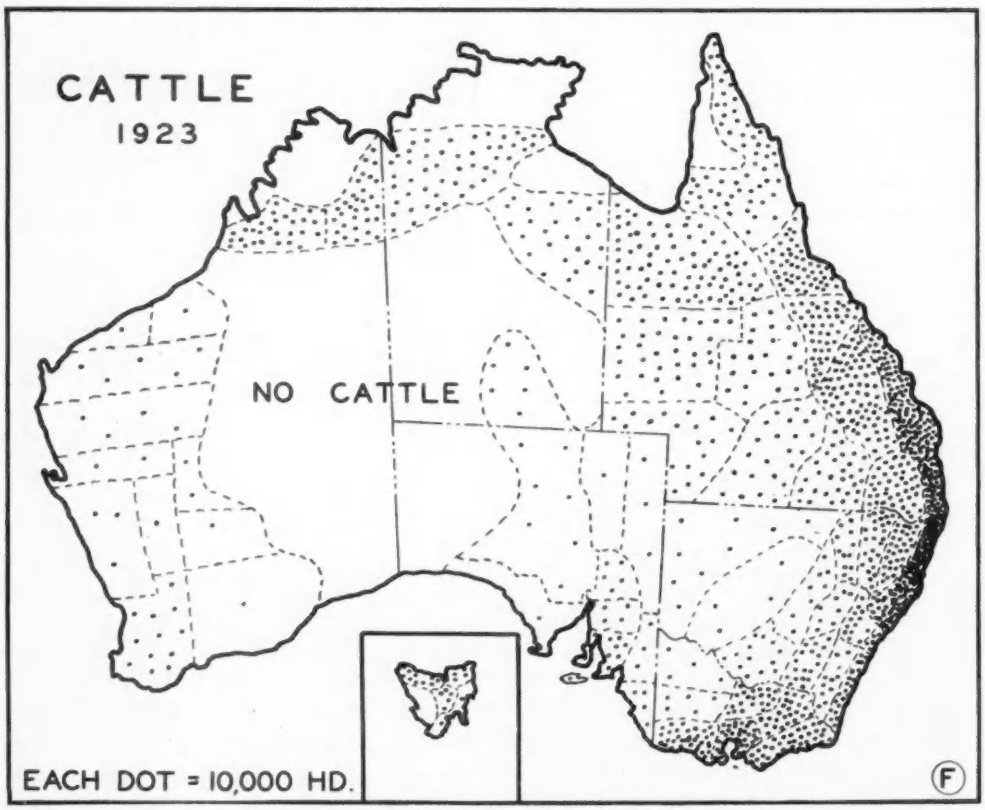



FIGURE 52.—The distribution of the cattle of Australia.

This is because they are hardier; they can travel about ten miles to water (as opposed to five miles for sheep), and they can withstand such pests as wild dogs.

### *Dairy Farming*

Three-quarters of the dairying is carried on in the States of New South Wales and Victoria. Cattle bred for dairy purposes need milder

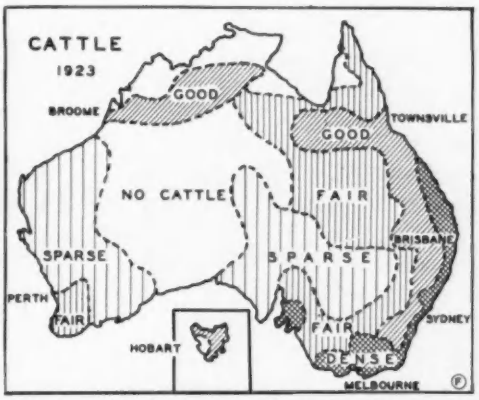



FIGURE 53.—This map of relative importance of the cattle industry in various sections of Australia supplements well the dot map of distribution in Figure 52.

climatic conditions than those reared for beef only, so that the chief dairy regions are along or near the coasts.

In New South Wales the center of the industry has migrated from the south coast to the north coast, where land is cheaper and the rainfall in general heavier than in the original center of dairying in the Illawarra district.

Along the coast the rainfall is uniform and reliable. Here also the evaporation is less than the rainfall, and hence the vegetation keeps green all the year round. There is, however, a great deal of milk and butter produced at some distance from the coast by farmers who combine dairying with wheat-growing or mutton-raising.

Seventy-five per cent of the milch cows in the State are in the coastal region, and no less than 277,000 (half of the whole number) are found on the north coast. Over one million acres are under sown grasses along the coast, and in the colder southern dairy districts a great deal of ensilage is prepared.

Victoria, however, led the way in dairying, and here it occupies a larger proportion of the State than in New South Wales. For the most part the cows are fed solely on natural pastures, but progressive farmers find it pays them to grow fodder for their herd and to shelter the animals in the winter.

FIGURE 54.—Ayrshire cattle are well adapted to the conditions of the better range country in West Australia. A herd on pasture near Toodyay. (Courtesy of West Australian Govt.)

Two-thirds of the dairy cows are kept in the Western District and in Gippsland. The former is famed for its rich volcanic soils and almost every town and hamlet has its butter factory. The rainfall varies from 25

FIGURE 55.—A typical pastoral scene at Newmarracarra, Swanland, West Australia, in a rich grazing and agricultural section. (Courtesy of West Australian Govt.)

to 30 inches. In Gippsland the rainfall is heavier, from 25 to 40 inches, and large areas were covered by heavy forest; but this is giving place to dairy farms, so that practically every railway station has become a center of the industry. Owing to its suitable climate, much maize is grown and much of this crop reaches the market in the form of butter and pork.

Queensland is rapidly progressing as a dairy country, especially the south coast and Darling Downs; while in South Australia the dairies spread from Port Germein (near the head of the Gulf), with a rainfall of only 13 inches, down to Mt. Gambier in the extreme south, with a rainfall of 32 inches.

### *Sheep*

In respect to the number of sheep, Australia leads the world. In 1924 there were over 93 million head, whereas Russia was far below with 67 millions and the United States with 41 millions. It is interesting to note how the number of sheep varies with the general character of the rains (Fig. 56). It is, of course, primarily the rain in the southeast of Australia which affects the sheep industry, since three-quarters of them live in this corner of the continent.

| | *1923* (In millions) | *1924* (In millions) |
|---|---|---|
| New South Wales | 37 | 47 |
| Victoria | 11 | 13 |
| Queensland | 17 | 19 |
| South Australia | 7 | 6 |
| West Australia | 7 | 6 |
| Tasmania | 1½ | 1½ |

Since New South Wales contains nearly half of the total number, we may consider their distribution here in a little more detail. The State may well be divided into four belts parallel to the coastline. In the East are the rather wet rugged coastlands which contain only a few per cent of the whole. The sheep are largely Romney Marsh and are grown chiefly for mutton. About one quarter of the sheep pasture on the Highlands, and consist chiefly of Lincoln, Leicester, or cross-bred sheep (chiefly with merino). These give heavier carcasses and coarser wool than the

pure merino. The next belt constitutes the western slopes and the Riverina, 60 per cent of the sheep grazing here. They are largely hardy merinoes, which thrive in spite of the relatively dry climate and produce fine staples which are readily purchased by wool buyers from all over the world (see Fig. 9).

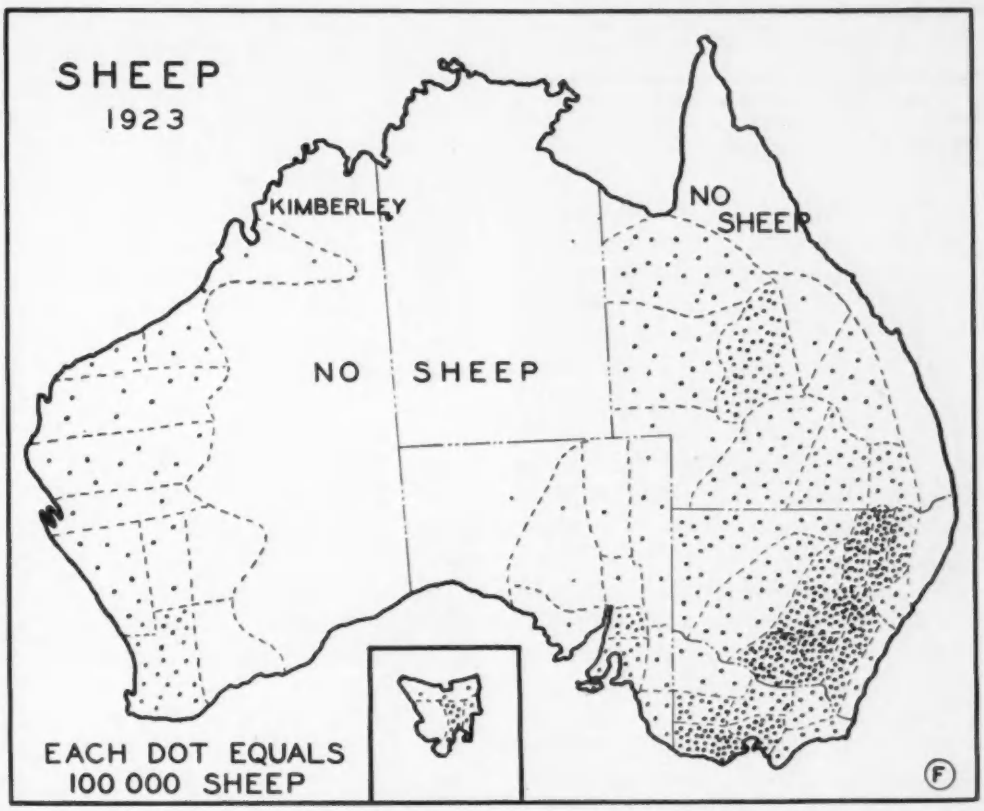



FIGURE 56.—The concentration of sheep to rather more restricted area than cattle occupy, as well as their distribution, is well revealed in this chart.

The northern limit in Australia seems to be defined partly by temperature and partly by the character of the resulting vegetation. Rank, spiny grasses are unsuited for sheep, and few are pastured where the temperatures exceed 75 degrees on an average. But as the ranker grasses are burnt out or eaten out by cattle, they tend to become more suited for sheep, so that we cannot yet be sure of their northern limit. At present, the sheep in the Kimberleys (West Australia) withstand an average temperature of about 82° (Fig. 57).

The following table shows the control exercised by rainfall.

RAIN CONTROL

| | *Optimum* (Inches) | *Total* (Inches) | *Chief Districts* |
|---|---|---|---|
| New South Wales | 20–30 | 10–40 | New England, Moree, Young, and Riverina. |
| Queensland | 15–20 | 10–30 | Longreach, Darling Downs, Cunnamulla, Clermont. |
| Victoria | 20–30 | 10–50 | Hamilton, Ballarat. |
| South Australia | 20–30 | 5–30 | Mt. Gambier, Adelaide. |
| West Australia | 20–30 | 8–40 | Swanland, Carnarvon, Fitzroy River. |
| Tasmania | 20–30 | 20–60 | Longford, Oatlands. |

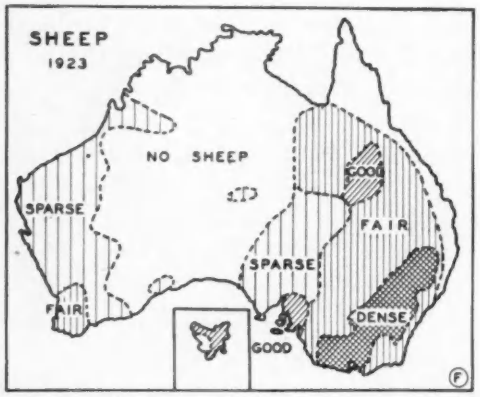



FIGURE 57.—The relative importance of the sheep industry throughout Australia is clearly indicated by this map.

The great drought [17] culminating in 1902 (when the sheep country in southern New South Wales received 9 inches instead of the normal 17 inches) resulted in a decrease of the total number from 95 millions to 55 millions. With each succeeding drought it is probable that these losses will be greatly minimized. Thus, around 1914 another series of bad seasons reduced them from 93 millions to 69 millions. As more railways are built, it will be possible to move the sheep to coastal regions where feed is usually available, and the tremendous losses of the past will not recur.

The close relation between the distribution of sheep and of rainfall is brought out by the following table,[18] which represents the conditions on an east to west section across New South Wales in a somewhat generalized fashion. It is to be noted that the densities are not for fully stocked country, but include the whole area of each of the counties involved in the census.

[17] *The Climate and Weather of Australia.* By H. A. Hunt, Griffith Taylor, and E. T. Quayle. Melbourne, 1913.

[18] Table based on Figure 14 in the writer's Bulletin, "Climate and Production," 1916.

| *Annual Rainfall in Inches* | *Sheep per Square mile* | *Representative District* | |
|---|---|---|---|
| 8 | 20 * | Milparinka | Wholly sheep |
| 10 | 70 | Wilcannia | |
| 15 | 100 | Hillston | |
| 20 | 180 | Forbes | Farming country |
| 25 | 250 | Young | |
| 30 | 350 | Tamworth | |
| 35 | 400 | Armidale | |
| 40 | 100 | Goulburn | |
| 45 | None | Few on South Coast | Dairy country |
| 50 | None | Too wet | |

* Estimated.

## DROUGHT

In more than one-third of Australia drought is a permanent condition, while exactly one-half of Australia receives practically no rain for six months of the year. It is, however, the borderlands between these arid regions and the well-watered districts where King Drought is most feared. For here grows our main wheat crop, and here are situated our chief stock regions.

FIGURE 58.—A flock of pure-bred border Leicester sheep at Temora, New South Wales. (Courtesy of New South Wales Govt.)

As regards the inland portion of South Australia, Victoria, and New South Wales, very dry conditions or true droughts have occurred about once every three years. Quayle cites the following (since 1880)—1881, 1884, 1885, 1888, 1895, 1896, 1897, 1899, 1902, 1907, and 1911. We may add the disastrous years of 1914, 1919, and 1923. Of these 1885 was bad only in South Australia, and 1911 had good rains in the least useful season (summer), while 1919 was worst in the Darling Basin.

### ARID PASTORAL COUNTRY

While it is true that a very great proportion of the stock is grazed in the wetter regions, yet considerable progress has been made in part of the really arid region. One of the most prosperous of the "desert" pastoral properties is situated 40 miles west of Broken Hill, and conditions here will indicate how much can be done with capital and initiative.

At Mutooroo the average annual rainfall is only 7½ inches, and the rain falls in almost any month of the year; while the evaporation is 90 inches. The "run" covers 3,000 square miles, and was originally waterless, *i.e.* containing no rivers, artesian or shallow supplies, except four small wells. It is an open saltbush (*Atriplex*) plain with a proportion of "scrub."

It now carries 33 sheep to the square mile, and this has been rendered possible by the excavation of 200 "tanks" costing over £100,000. Some of these tanks are huge excavations 100 yards long, 80 yards wide, and 25 feet deep. They collect surface water after the infrequent rains, which is then pumped to the 600 paddocks into which the run is subdivided. It is obvious that many years of effort and an enormous outlay are necessary before such country can be profitably exploited. But the huge unoccupied areas in the south with similar climatic conditions make the lesson an invaluable one. It is to be noted that in the northern arid regions a very much higher rainfall (about 14 inches) would seem to be necessary to obtain equivalent results, owing to the occurrence of a much greater evaporation and also of a long winter-drought season.

### SUMMARY OF AGRICULTURAL REGIONS

In recent geographical studies (*e.g.* that of Europe by Jonasson) it has been found useful to use a combined form of map based both on the natural vegetation, and on the uses to which the land is put by man. Since so small an area of Australia is under cultivation (16 million acres out of 1,900 million acres), it is obvious that the areas devoted to individual crops are too small to show on the map of the continent.

In the map those regions where crops have been grown are outside the heavy line. The remainder is either pasture or desert, or a combination of both. In the map a sort of duplex nomenclature is used which emphasizes the fact that it is almost impossible in most regions to define them as belonging to one type. Each type grades imperceptibly into the next and in general the dominant type in the region is mentioned first and the subordinate type is suffixed to the name.

FIGURE 59.—Merino sheep constitute one of the most dependable sources of income. A flock near Burrawong Station in the Riverina district of southern New South Wales. (Courtesy of New South Wales Govt.)

Since Australia is a continent with an unusually large proportion of hot arid lands (65 per cent receiving less than 20 inches of rain, while Africa

has only 54 per cent), it is obvious that certain regions will differ considerably from those found for instance in Jonasson's map of Europe. The types which the writer has adopted are given in the following table, where their position in the seven main divisions of the Commonwealth is also indicated. The order given is approximately that of their value as producers.

Even in the densest agricultural region of Australia there are still large areas of the original vegetation, so that the character of the latter may well be summarized before the distribution of the crops is entered upon.

### 1 AND 4. CROP-PASTURE AND PASTURE-CROP REGIONS IN SOUTHEAST

This consists of a region with an annual rainfall between 12 and 20 inches, mostly falling in winter. The vegetation is formed of savannah forest or Mallee for the most part. Thus, in South Australia and Victoria large areas are covered by a dwarf eucalyptus (Mallee) which grows with clustering stems, and is often removed for crops by rolling it down. On the wetter side are thin forests of various eucalyptus (such as Ironbarks and Boxes) and Pines (*Callitris*) with many smaller Acacias, Grevillias, and Eremophilas. Much grass and in the drier parts Saltbush (*Atriplex*) cover the ground; so that sheep almost invariably form part of the wheat farmer's assets. Crops are more abundant in the south, sheep in the north of this belt.

| *Agriculture* | *Victoria* | *New South Wales* | *Queensland* | *South Australia* | *West Australia* | *Tasmania* | *Northern Territory* |
|---|---|---|---|---|---|---|---|
| 1. Crop-Pasture | North | South | ..... | South | ..... | ..... | ..... |
| 2. Crop-Forest | South | East | ..... | ..... | ..... | ..... | ..... |
| 3. Forest-Crop | Northeast | East | East | ..... | Southwest | ..... | ..... |
| 4. Pasture-Crop | Southwest | North Center | Southeast | Southeast | ..... | Center | ..... |
| 5. Forest | East | Southeast | ..... | ..... | Southwest | West | ..... |
| *Pasture* | | | | | | | |
| 6. Pasture-Bush | ..... | ..... | Center | ..... | Northeast | ..... | North |
| 7. Pasture | ..... | West | Southwest | ..... | Northeast | ..... | North |
| 8. Bush-Pasture | ..... | ..... | North | ..... | North | ..... | North |
| 9. Desert-Pasture | ..... | ..... | ..... | Center | Center | ..... | South |
| *Desert* | ..... | ..... | ..... | Northwest | Center | ..... | South |

### AGRICULTURE

The crop-pasture region contains almost all the wheat-lands of the southeast, and thus by far the most important portion of the cultivated lands. In New South Wales this involved (in 1923) wheat (worth £6 millions), and most of the hay (worth £9 millions). In Victoria wheat (in 1924) was worth nearly £12 millions, and hay £4 millions, while oats was nearly £1 million. In South Australia wheat produced £7 millions, hay £2 millions, barley and oats £1 million, and vineyards £1 million.

FIGURE 60.—Cocoanut palms near Port Douglas on the east coast of North Queensland. These palms are not at all common. (Courtesy of Dept. Agric. and Stock, Govt. of Queensland.)

FIGURE 61.—Hauling timber to the mill near Lamington in the Beaudesert district of the highlands of southeastern Queensland. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

All the agriculture in this last State is included in regions 1 and 4. In Queensland wheat accounts for £1 million; and in Tasmania potatoes and apples each are worth nearly £1 million, and hay £½ million.

### STOCK

In the small regions in the east are found nearly half the sheep of Australia, *i.e.*, somewhere about 34 million head. Cattle are much less important, though there are about 2 million head.

#### 1. CROP-PASTURE—THE GREAT WHEAT-SHEEP BELT

C. P. 1. *Wimmera-Riverina*—Chief wheat and irrigation region in Australia. Cattle and sheep more important in southern half.

C. P. 2. *Adelaide District*—Intense wheat, some vines and barley. Cattle and sheep important throughout.

C. P. 3. *Mallee*—Sparse wheat, some cattle and sheep.

C. P. 4. *Eyre's Peninsula*—Sparse wheat, cattle and sheep. (Much saline country.)

C. P. 5. *East Swanland*—Originally rather open forest. Now important wheat, some sheep and cattle.

C. P. 6. *Southeast Swanland.*—Like East Swanland, but poor soils and no wheat. Few sheep and cattle.

#### 4. PASTURE-CROP—GREAT SHEEP REGION, WHEAT SUBORDINATE

P. C. 1. *Great Valley of Victoria*—Dense sheep and cattle. Wheat sparse, oats more important.

P. C. 2. *Western Slopes (New South Wales)*—Very important sheep. Wheat good, cattle less important.

P. C. 3. *Darling Downs*—Chief wheat of Queensland. Some maize and lucerne, good cattle and sheep.

P. C. 4. *Maranoa*—Good cattle and sheep, sparse wheat and little cotton.

P. C. 5. *Northern Plains (New South Wales)*—Good sheep, sparse wheat and cattle.

### 2 AND 3. CROP-FOREST AND FOREST-CROP

These regions contain notable forest timbers, and are, of course, confined to the areas with fairly uniform rain, which exist only along the east and southwest coasts. The natural vegetation, beginning in the far south, consists of thick "brushes" of beech (*Fagus*) and Acacia, but these are giving way to dairy farms. There are large areas of hill country covered with Eucalyptus, of which one species (*E. Regnans*) is stated to reach 300 feet or more. *E. Obliqua* and *E. Amygdalina* are common in Victoria, while other eucalypti such as Iron-

bark, mahogany, and Red Gum are also common trees. On the north coast of New South Wales are thick "brushes" of tropical types such as *Cedrela*, *Flindersia*, and *Doryphora*. These extend along the coast up to North Queensland, together with *Dysoxylon*, *Castanospermum*, and *Araucaria*. The "brushes" are laced together by lianas, and are very different from the open "parkland" forests of most of Eastern Australia. Where the rainfall in the southwest corner of the continent exceeds 25 inches, a valuable forest of Eucalyptus is found. A valuable export industry has grown up, the chief trees being Jarrah and Karri. The country is slowly being converted into dairy farms and orchards, but their total value is not large yet, for settlement is still very sparse. In the two regions, East Swanland and Maranoa, the sheep number about 8 millions and the cattle about 850,000.

### AGRICULTURE

These regions are too wet for wheat, but contain the chief dairy farms of Australia. Here also is the sole tropical agriculture in Australia. Thus, Queensland (in 1923) produced sugar cane worth £6 million, maize and forage each worth nearly £1 million, and lucerne and bananas each £½ million. In New South Wales maize was worth £1 million, green forage and fruit each £¾ million, and oranges about £½ million. In Victoria there is not so much wheat, but dairy-farming is general in this southeast portion. However, much consists of rugged untouched forest.

### STOCK

There are about 8 million sheep in the inner drier portions of these areas, and about 5 million cattle in the agricultural regions under consideration.

2. CROP-FOREST—DAIRYING BELT
(Dense cattle throughout)

C. F. 1. *Brisbane and Lismore District*—Maize, oats, lucerne, sugar, and bananas.

FIGURE 62.—A successful banana plantation, won from the original forest, at Kandanga, near the Queensland coast. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

C. F. 2. *North Coast* (*New South Wales*)—Chief maize district in Australia. Some oats and lucerne.

C. F. 3. *Sydney District*—Market gardens, orchards. Little maize and oats.

C. F. 4. *South Coast* (*New South Wales*)—Some sheep, maize, and oats.

C. F. 5. *Gippsland*—Orchards, some maize, sheep, oats, potatoes, little beet sugar.

C. F. 6. *Central Tasmania*—Oats, orchards, little wheat, some sheep. Potatoes in north.

3. FOREST-CROP—LESS IMPORTANT DAIRYING BELT

F. C. 1. *North Queensland Coast*—Sugar, tropical fruits.

F. C. 2. *Central Queensland Coast*—Like North

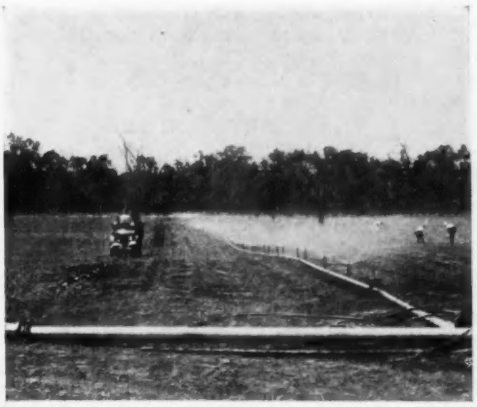


FIGURE 63.—Intensive tobacco culture in a continent of generally extensive agriculture. Planting and irrigating tobacco at Texas, South Queensland. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

Queensland coast, but less sugar. Chief cotton area in Australia.

F. C. 3. *Emerald District*—Chiefly cattle, but a little agriculture.

F. C. 4. *West Swanland (West Australia)*—Orchards, timber, some sheep.

## 5. FORESTS

Apart from the jungles and thick forests of the coasts, which are giving place to agriculture and are described under Forest-Crop, there are large areas of open forest in highland country which are little altered from their original condition. Cattle and sheep find pasturage in many parts of the highlands, their density decreasing to the south as the highlands become bleaker and less closely wooded. The New England Plateau has some agriculture in the west, but the high Blue, Bogong, and Tasmanian Plateaux are of little importance even for stock.

5. FOREST—CHIEFLY SPARSE CATTLE

F. 1. *New England Plateau*—Dense sheep and many cattle.

F. 2. *Blue Plateau*—Many cattle and sheep, little agriculture in valleys.

F. 3. *Bogong-Kosciusko Plateau*—Few cattle on highlands, sheep in valleys.

F. 4. *Monaro Uplands*—Important cattle and sheep.

F. 5. *Tasmanian Plateau*—Few sheep and cattle some sawmills. ?

PASTURE

Three somewhat arbitrary types of pasture country have been delimited, based partly on the density of the stock. Much the same kinds of vegetation are found throughout, various types of Acacias being the dominant tree. In the north with summer rain, grasses are dominant; in the south with winter rain, saltbush is more abundant.

## 6. PASTURE-BUSH

This type of country is almost wholly found in tropical lands, with a rainfall of 20 inches, nearly all falling in summer. Mitchell grass (*Astrebla*) is common, while false spinifex (*Triodia*) occurs in the sandy districts. Brigalow (*Acacia sp.*) is abundant in clumps with many similar trees from 10 to 30 feet high. *Casuarina*, *Bauhinia*, and *Eremophila* are associated with them. There is no agriculture.

STOCK

In the west in Kimberly there are about 200,000 sheep and 600,000 cattle. In the Victoria River Basin (Northern Territory) there are about 500,000 cattle and no sheep. In the Queensland region there are 9 million sheep and about 3 million cattle.

6. PASTURE-BUSH—IMPORTANT STOCK

(N. B.—Future sporadic agriculture is possible)

P. B. 1. *Queensland Downs*—Important cattle and fair sheep.

P. B. 2. *Longreach District*—Important sheep, fewer cattle, valuable artesian water.

P. B. 3. *Fitzroy-Victoria Basins*—Important cattle, few sheep in west.

## 8. BUSH-PASTURE

Along the north coast of Australia is a region with a fairly heavy summer rainfall (varying from 30 to 50 inches), but which is of very little economic importance. The soils are poor, the grasses are rank, and ticks are fairly prevalent. As a conse-

FIGURE 64.—A mango tree heavily laden with luscious fruit near Brisbane. (Courtesy of Dept. of Agric. and Stock, Govt. of Queensland.)

quence cattle are not numerous, though there are 500,000 in the Cape York Peninsula. The vegetation is much like that in the Pasture-Bush region; but Pandanus, Baobab, and other tropical forms occur.

8. BUSH-PASTURE—SPARSE CATTLE

B. P. 1. *Peninsula*—Fair cattle country.
B. P. 2. *North Kimberley*—Rugged, possible for cattle.
B. P. 3. *Arnheim region*—Poor pastoral possibilities.

## 7. PASTURE

In this region the rainfall is only from 10 to 20 inches, and falls chiefly in summer. The trees are smaller and occur in clumps, especially along the beds of the intermittent streams. They are largely acacias, mulga being common. Mallee is abundant in the south with poplar-gums, white box, etc. Eremophila and Myoporum are common small trees. Mitchell grass and saltbush both occur.

STOCK

There are about 7½ million sheep and 1 million cattle in this portion of the continent.

7. PASTURE—IMPORTANT STOCK

(N. B.—Future sporadic agriculture possible)
P. 1. *Southwest Queensland*—Artesian water, both sheep and cattle.
P. 2. *Darling Basin*—The chief merino country (few cattle). Irrigation along the Murray River.
P. 3. *Barkly Uplands*—Cattle only.

## 9. DESERT-PASTURE

This is a region of low rainfall (around 10 inches) and high evaporation (around 100 inches). The vegetation is intensely xerophytic, consisting essentially of mulga (Acacia) and false Spinifex. But grass and saltbush occur in places, especially in the flat swampy lands into which the intermittent rivers drain. Some of the mulgas and spinifex are eaten by stock, which thus survive the droughts. The region is capable of producing fine cattle, provided they have water enough and are given enough area per head. The total numbers are not large, considering the huge area involved. There are about 2½ million sheep and 150,000 cattle in the Western Australian portion. In South Australia one million sheep and 100,000 cattle, and in Northern Territory about 69,000 cattle and 4,000 sheep live in the Desert-Pasture region.

9. DESERT-PASTURE REGION—VERY SPARSE STOCK

D. P. 1. *Western Plateau*—Sparse cattle and sheep.
D. P. 2. *Lake Eyre Lowlands*—Sparse cattle and sheep. Some Artesian water.
D. P. 3. *Macdonnell Highlands*—Sparse cattle and sheep.
D. P. 4. *Barrow Creek Uplands*—Almost empty.
D. P. 5. *Nullarbor*—Almost empty.

## DESERT

In this area of over half a million square miles, the country consists largely of fixed dune, hamada, or pebble (gibber) plains.

10. DESERT—UNINHABITED

D. 1. *Western Desert*—Largely fixed dunes or hamada.
D. 2. *Arunta Desert*—Largely fixed dunes.

It contains no stock, and is entirely uninhabited by white settlers.

# THE PASTORAL AND AGRICULTURAL INDUSTRIES OF KENYA COLONY AND PROTECTORATE

*Earl C. Case*

Geographer, University of Cincinnati

THE Colony and Protectorate of Kenya are very nearly bisected by the equator (Fig. 1), and yet the major activities of the people would scarcely suggest this low-latitude position. The most important native industry is the pasturing of cattle, sheep, and goats, which number at present almost ten million head. Such richness in useful animals is foreign to most equatorial areas. It is in sharp contrast to conditions within the hot humid forests of western equatorial Africa, where one may travel hundreds of miles without seeing a single herd of cattle or flock of sheep or goats except, perhaps at some missionary station, where a few cows may be kept for dairy purposes.

The agriculture of Kenya varies greatly from one section to another, both in the kinds of crops grown and in the methods of cultivation. The heart of Kenya, however, is the upland area of the southwest where European settlers are developing modern plantations and ranches on an extensive scale. This area has been brought under cultivation with remarkable rapidity and is today the source of the major exports of the Colony. The most important commercial crops are maize and wheat—grains usually associated with temperate climates; coffee, a product grown most abundantly in subtropical areas; and sisal, a drought-resisting plant which requires long dry periods for the production of high-quality fiber. The distribution of the various crops of Kenya is closely related to climatic conditions which in turn depend largely upon topography and proximity to the sea (Figs. 2 and 3).

## Climate and Agriculture

Kenya is rather sharply divided into three agricultural units based primarily on differences in rainfall and temperatures. They are: (1) the hot humid southeastern coast suited to the production of many tropical products; (2) the remaining lowlands (about 65 per cent of Kenya) where, as a result of heat and scant rainfall, most of the land still lies waste or affords uncertain pasture; and (3) the uplands of the southwest where, under European management, the cultivation of the land is increasing rapidly.

Although the Colony and Protectorate cover an area of 209,000 square miles, less than one-fourth of it has rainfall sufficiently heavy and reliable for the promotion of agriculture, and perhaps another one-half supports poor to fair pasture. The remaining one-fourth is desert or near-desert.

The low narrow coastal strip, varying in width from 3 to 20 miles, is hot, debilitating, and ill-suited as the home of European peoples. Within the southern part annual precipitation exceeds 40 inches and is sufficient for the cultivation of rice, maize, coconut palms, mango palms, sisal, bananas, and many other prod-

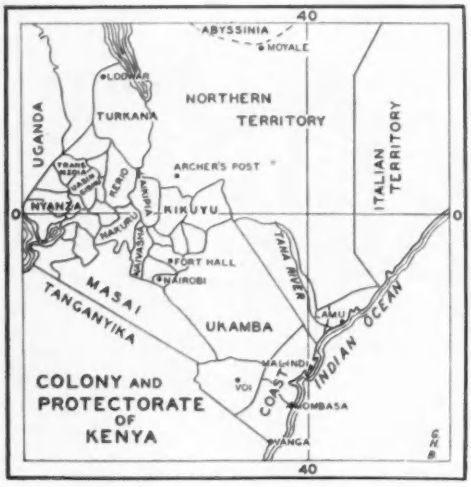



FIGURE 1.—Place map of Kenya.

ucts. Towards the north, the rainfall decreases and becomes more concentrated until at Lamu, the bush-covered desert comes down to the coast and none of the land is cultivated[1] (Figs. 4 and 5).

Just back of the coastal strip extends a low range of hills which, although rocky and eroded, has sufficient precipitation to support a sparse population.

Behind these hills lies the *Nykia*, an area usually described as a desert belt, except during the rains when for a short period vegetation is more abundant. The grass and sedge which grow in little tufts are so widely scattered that the general tint of the landscape is that of the soil. Most of the plants are thorny or fleshy, as is usual within all desert areas. The average annual rainfall is about 25 inches in the southern part of the *Nykia*, but towards the north it decreases to 15 inches or less (Fig. 5). The average, however, is not very significant because of the wide variation from one year to another. In 1926, the rainfall at Voi was but 6.34 inches.

[1] Handbook of Kenya and Protectorate, 1920, p. 30.

The Northern Frontier Province and Turkana, which occupy slightly more than one-half of Kenya, have an exceedingly light and unreliable rainfall. Part of Turkana is true desert. The average annual rainfall at Lodwar, just west of Lake Rudolf (Fig. 1), is but 5.36 inches[2] and the country takes on something of the appearance of the Sahara. A season of exceptionally light rainfall in Turkana is the cause of many raids in which the pastoral tribes attempt to replenish their food supply by appropriating the flocks and herds of their neighbors.

The Northern Frontier Province is

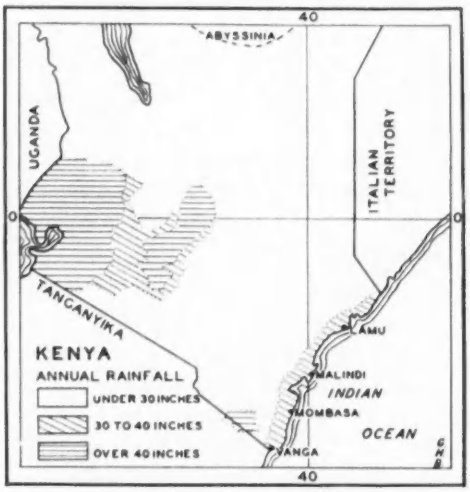



FIGURE 2.—Rainfall map of Kenya.

almost entirely desert and the population is less than one per square mile. Except for the production of a little maize on some of the higher elevations, and some millet along the Tana River, agriculture is non-existent.[3] At Wajar, the average annual rainfall is but 7.87 inches (Fig. 5) and during dry years it is much less. At Archer's Post, on the border of the

[2] Colony and Protectorate of Kenya, Meteorological Records, Dept. of Agr., 1926, p. 9.

[3] Op. cit., Native Affairs, Dept. Ann. Report. 1926, p. 46.

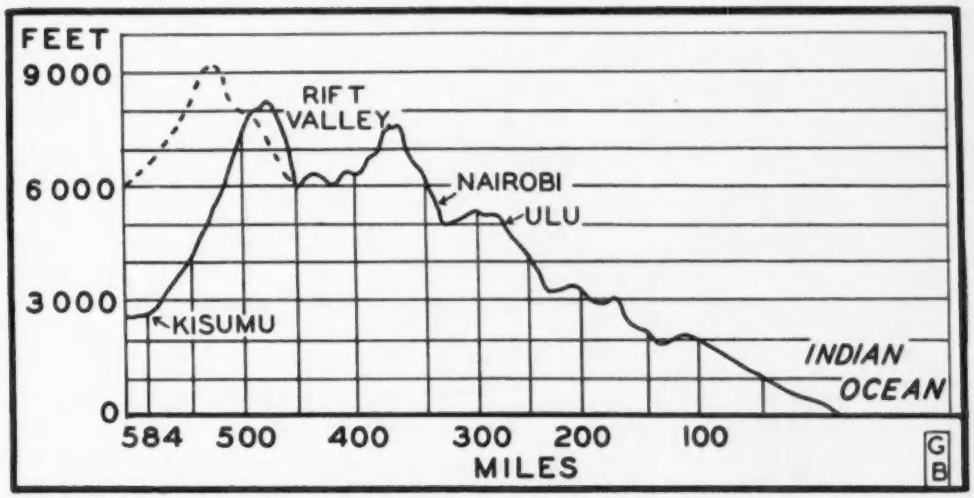



FIGURE 3.—The solid line represents the elevations along the Kenya-Uganda Railway. The dotted line represents the elevations along the Uasin Gishu branch line.

Highlands the average annual precipitation is 15.92 inches, but during nine or ten months of each year the ground is parched by the tropical sun.

The Highlands of southwest Kenya present a much more encouraging outlook. This area, consisting of about 35,000 square miles, is the best watered part of Kenya (Fig. 2), supports more than three-fourths of the total population, and has recently become the dominant agricultural center of the Colony. Even here, however, the rainfall is by no means as reliable as it is in most parts of humid United States. Normally there are two rainy seasons (Fig. 5), but at times one or both of these practically fail. Years of abundant precipitation and excellent pastures and crops are followed by protracted droughts and famine. The last severe famine of Kikuyu occurred in 1898–1899, when the rainfall was less than one-half the average for the eight preceding years. This drought of eighteen months' duration caused a famine "unparalleled within native memory. . . . It was contended by survivors that three out of every four of the Kikuyu residents, in extensive stretches of country, died either from famine or small pox."[4]

While the famine was at its worst, two steps were being taken by the

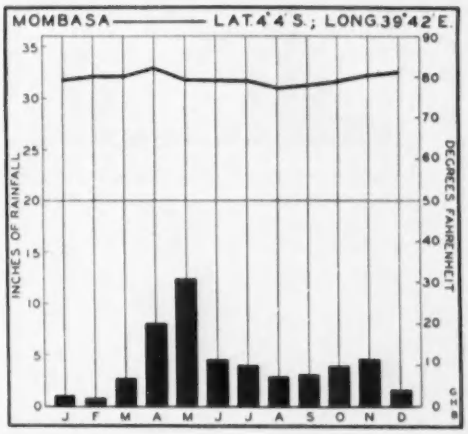



FIGURE 4.—Rainfall by months at Mombasa.

British which should prevent, or at least alleviate, famine conditions in the future: first, the methods of transportation were being improved and soon railways and motors began to replace human carriers; and second, new crops and scientific methods

[4] Ross, W. McGregor. "Kenya from Within." Geo. Allen & Unwin, London, 1927, p. 62.

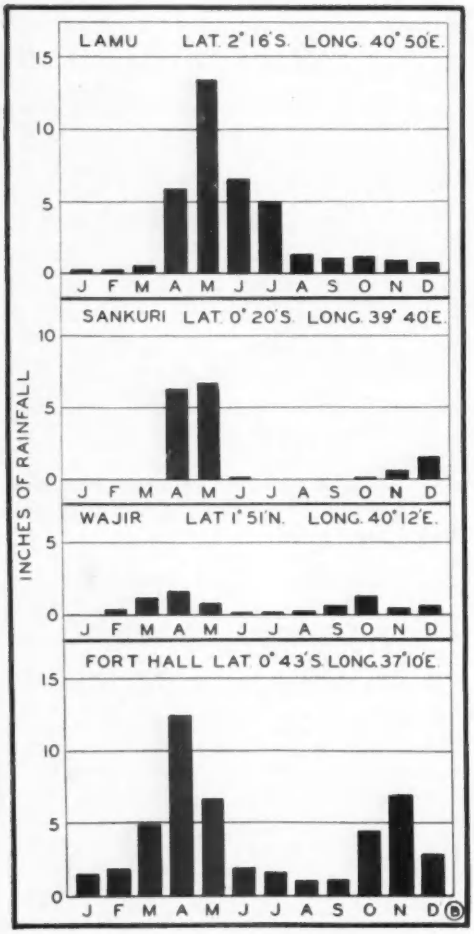



FIGURE 5.—Rainfall by months at four stations in Kenya, indicating its seasonality.

of agriculture were being introduced into the Highlands by European settlers.

### NATIVE AGRICULTURE

The beginnings of agriculture in Kenya are obscure. It is most probable that a few centuries ago all of the tribes were pastoral and hunting peoples. Even when the British settlers arrived at the beginning of the present century, flocks and herds represented the sole wealth of the most powerful tribe—the Masai.[5] It was preëminently this tribe which held vast tracts of land from being occupied and used, thereby keeping them open for European penetration. To the Masai also may be attributed the persistence and increase in wild fauna which make Kenya Colony one of the most richly stocked big-game countries in the world. These pastoral people waged unceasing war against the lion, thereby restricting the serious toll that it levied upon their flocks and herds and upon the antelope of the plain. They did not kill and eat the game themselves, and they kept hunting tribes off the prairies where the game abounded.

The chief food of the Masai was sour milk, meat, and blood from their own herds. They drank the blood while it was still warm, and just as it was drawn from a vein in the animal's neck, after which the wound was closed and the animal turned loose to recover. The diet of certain other tribes was obtained almost exclusively from wild game of which there was an abundance in Kenya, while still other tribes had developed primitive agriculture to supplement the food obtained from hunting and pastoral pursuits.

FIGURE 6.—The natives of Kenya planting corn with sharpened sticks. Mr. L. W. Kephart, who took the picture, said that this is the only group of men he saw working on native farms within Kenya. Most of the agricultural work is done by women. (Courtesy of L. W. Kephart, Foreign Crops Division, U. S. Dept. of Agric.)

Early records seem to indicate that the Kikuyu tribes had sur-

[5] Buxton, M. Aline. "Kenya Days." Edward Arnold & Co., London, 1927, p. 56.

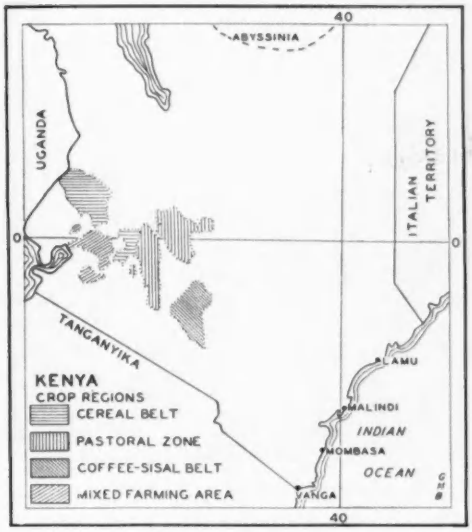



FIGURE 7.—The shaded areas represent sections of the Highlands which have been alienated —set aside for European settlement.

passed all others in the development of agriculture. Their territory, situated in eastern Kikuyu, was described by Mr. Francis G. Hall, after whom Fort Hall is named, as being about 100 miles in length and 15 to 18 miles in breadth. He wrote: "With the exception of small patches of excellent grass, which are kept for grazing purposes, and a few small swamps, every available piece of ground is under cultivation, and the district may be described as one vast garden." Still earlier Captain Lugard had reported: "The cultivation of Kikuyu is prodigiously extensive, indeed the whole country may be said to be under tillage. Beans of various kinds are the staple, grain being comparatively little grown at present."[6]

There is evidence that at one time agriculture was highly developed along the coast by Arab planters, but with the abolition of slavery, and the relaxation of despotic control, the coast peoples have sunk back into the lethargy from which their conquerors had aroused them.

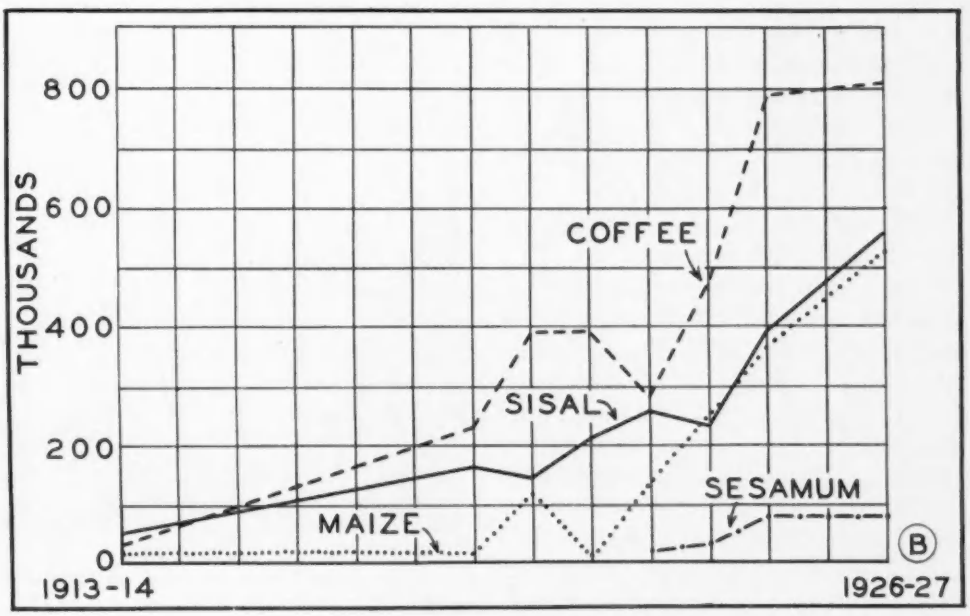



FIGURE 8.—The principal exports of Kenya (000 omitted).

No accurate data have been col-

[6] Lugard, Captain F. D. "The Rise of Our East African Empire," p. 328.

FIGURE 9.—A coffee plantation of Kenya. The large trees in the background are grown to shade the coffee trees and to protect them from the hot drying winds.

lected which indicates the extent of native cultivation. It is known, however, to have been small before the arrival of white settlers, except a'ong the coast, on the eastern border of the Highlands, and within a few other scattered areas. Previous to the construction of the Kenya-Uganda Railway, the Mau Plateau contained vast stretches of land entirely uninhabited; today these lands constitute the principal cereal-producing area of Kenya.

Since 1900, agricultural development has gone forward with rapid strides, primarily on European plantations. Native agriculture is chiefly the subsistence type and but little surplus is produced for export. In 1927, the exports from European farms were valued at more than ten million dollars, whereas, the non-European exports, including those produced by Indian farmers, were worth only about one-fifth as much.[7]

The natives possess but little agricultural machinery. In most cases the ground is merely dug over lightly with hoes or sharpened sticks and the crops planted in poorly prepared soil (Fig. 6). Plows are sometimes pur-

FIGURE 10.—Picking coffee in Kenya. (Courtesy of Foreign Crops Division, U. S. Dept. of Agr.)

chased by communities, but rarely by individuals. The most encouraging results thus far were obtained in 1926, when the natives of Nianzi purchased 87 plows. Yet, it must

[7] Colony and Protectorate of Kenya, Agricultural Census, Nairobi, 1928, p. 26.

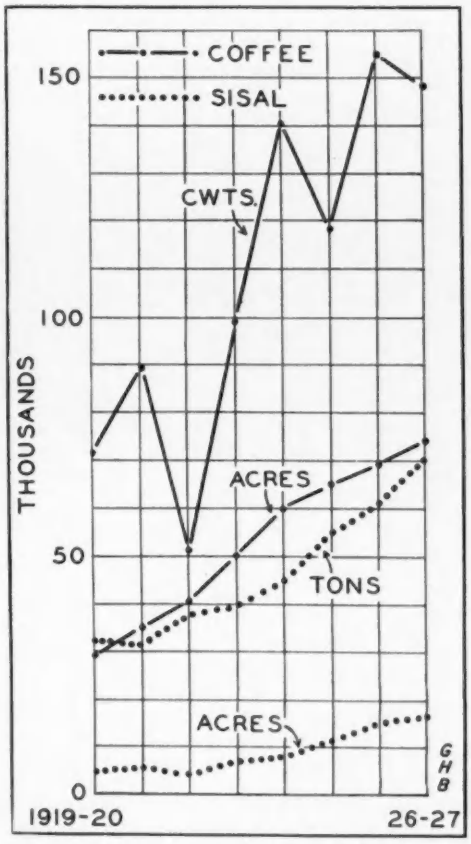



FIGURE 11.—Acreage and production of coffee and sisal (000 omitted).

be remembered that this record sale represented only one plow for each 120 square miles of territory or for each 115,000 people.

### NATIVE AGRICULTURE VERSUS PLANTATION AGRICULTURE

It may be somewhat surprising to learn that native cultivation is developing more rapidly in the hot lowlands of Uganda than on the pleasant uplands of Kenya. This is largely a result of the difference in labor policies of the two colonies. In Kenya the natives are urged to work on European plantations, and if the number of willing workers is not sufficient to meet the planters' needs, more are recruited, by coercion if necessary. As a result the number of natives under European employment increased from 12,000 in 1912, to 185,000 in 1927. This labor policy of Kenya is in sharp contrast to that fostered in Uganda, Belgian Congo, the Gold Coast, and other tropical lowlands where the natives are encouraged to till their own land and to sell the surplus products to European merchants. The differences in policy is due to the fact that the Kenya Highlands are suited to white settlement, while within the equatorial lowlands the oppressive heat and humidity prevent true European colonization. The result of the labor policy of Kenya as compared with that of other areas is clearly shown in Table 1.

TABLE 1

PERCENTAGE OF ADULT MALE POPULATION UNDER EUROPEAN EMPLOYMENT *

| *Territory* | *Adult Male Population* | *Number Continually Employed* | *Per Cent of Adult Male Population Employed* |
|---|---|---|---|
| Kenya | 500,000 | 169,000 | 33.8 |
| Belgian Congo | 2,100,000 | 300,000 | 14.3 |
| Gold Coast | 495,000 | 25,000 | 5.4 |
| Uganda | 629,000 | 25,000 | 4.0 |
| Nigeria | 3,732,000 | 80,000 | 2.1 |

* Buell, Raymond L. "The Native Problem in Africa." The Macmillan Co., 1928, p. 346.

It is estimated that by 1929 more than 40 per cent of the adult male population of Kenya will be needed to care for European plantations, unless labor-saving machinery or labor-saving crops are introduced on a larger scale.

### NATIVE PASTORAL INDUSTRY

The tending of flocks and herds is the most important native occupation in Kenya, and the number of cattle, sheep, and goats owned per capita is more than twice that of the United States. Two and one-half million people own approximately ten million head of livestock (Fig. 2),

but unfortunately most of the native animals are of inferior quality.

TABLE 2

NATIVE OWNED LIVESTOCK OF KENYA, 1926

| | |
|---|---|
| Cattle | 3,298,000 |
| Goats | 3,698,000 |
| Sheep | 2,535,000 |
| Camels | 60,000 |
| Donkeys | 35,000 |
| Horses and Mules | 100 |

In the hot coastal lowlands, 60,000 camels and 10,000 donkeys represent almost the only beasts of burden except man. One traveler has written, "The donkey and the camel make an incongruous appearance as they walk side by side heavily laden with merchandise." Oxen are poorly suited to the coast because of the ravages of the tsetse fly, rinderpest, and the coast fever.

The coast also supports about 200,000 sheep and goats. The sheep do not grow wool, but hair, and, like the goats, are raised primarily for their meat and hides.

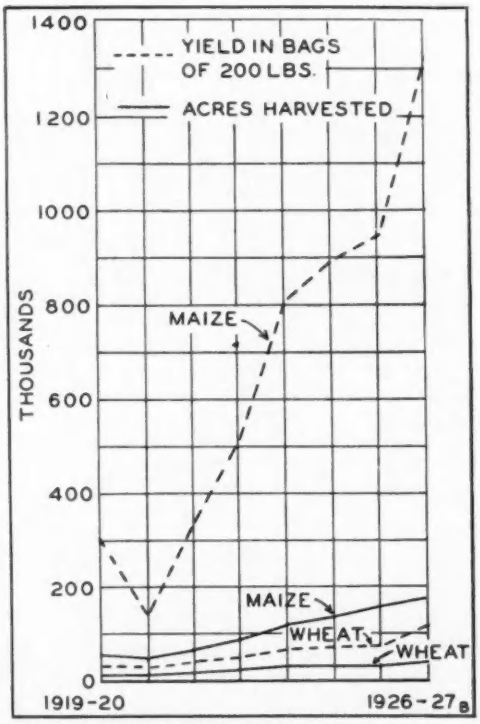



FIGURE 13.—Maize and wheat acreage and production (000 omitted).

The Northern Frontier and Ukamba, which include slightly more than 60 per cent of Kenya, support about 1,000,000 head of cattle and 1,800,000 head of sheep and goats. The Tana River and the scattered areas of higher elevations are the life of these provinces. Although most of the Tana River has been included in the Coast Province, the climate is similar to that of the adjoining parts of the Northern Frontier. The Tana

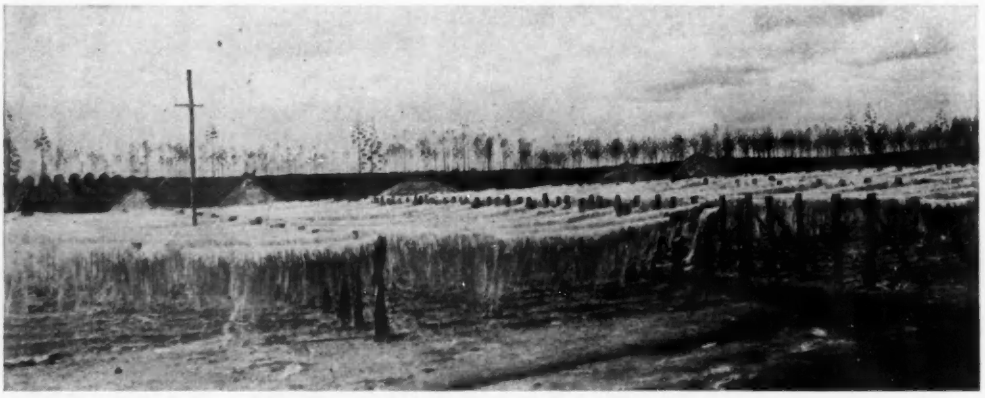


FIGURE 12.—The background shows a field of mature sisal, in the center may be seen piles of leaves ready for the decortication plant, and the foreground shows the sisal fiber drying in the sun. (Courtesy of Foreign Crops Division, U. S. Dept. of Agr.)

River which floods its banks every winter is sometimes called the Nile of Kenya. These floods provide moisture for pasture and for the cultivation of millet.

The best grazing areas of Kenya are found in the Highlands where more than two-thirds of all the livestock are pastured. Here the pastures are richer and more reliable than in the Lowlands, and the cattle are immune from the ravages of the tsetse fly. There have been, however, serious outbreaks of coast fever, rinderpest, and pleuro-pneumonia.

areas of land totally unoccupied except for big game, and of other areas wastefully used for grazing. Yet, the rapid development of these lands was out of the question because of poor transportation facilities. The only products which could be exported were slaves, who could walk to market, and ivory, which could bear the cost of expensive transportation. The Highlands of Kenya were seldom raided for slaves, partly because of the difficulty of crossing the desert back of the coast, and partly because of the fear of the

FIGURE 14.—A wheat field within sight of the equator. Upon the high tableland of the Uasin Gishu Plateau, excellent crops of wheat are grown. The American-made binder is pulled by oxen, as horses do not thrive within this area. (Courtesy of Foreign Crops Division, U. S. Dept. of Agr.)

## EUROPEAN PLANTATION AGRICULTURE

It is interesting for one to note the important part that transportation plays in the development of plantation agriculture.

### THE NECESSITY OF RAILWAY COMMUNICATION

Amazing tales of the wonderful temperate-zone climate and fertile soils of the Kenya Highlands were told with increasing frequency after 1885. Early travelers in East Africa also recorded the existence of large

fierce Masai, who occupied part of this upland area. Occasionally, however, when traders found ivory difficult to obtain, they resorted to the slave traffic so as not to return to the coast empty-handed.

The first requisite for the development of plantation agriculture was some improved method of transportation. The Highlands lie 300 to 500 miles from the coast. No navigable rivers afford a highway to the sea, and beasts of burden could not be used because of the ravages of the tsetse fly. Human portage was almost the only means of transporta-

tion, and that was costly. It was estimated that human portage in legitimate trade cost about 75 cents per ton per mile. Thus, each ton transported from the Highlands cost approximately 300 dollars carrying charges alone—a cost prohibitive for most agricultural products.[8] Apart from the monetary expense, human portage in this part of Africa was extremely costly in life. Two thousand natives died of dysentery in a single caravan while crossing Kenya from the Uganda border. In addition, these porters were the means of conveying epidemics all along the route and into their home villages. Under such conditions it was only natural that plantation agriculture should await the construction of a railway which was completed across the Kenya Highlands to the Uganda border in 1901.

FIGURE 15.—The Uasin Gishu Plateau is well suited to hog-raising. (Courtesy of Foreign Crops Division, U. S. Dept. of Agr.)

### EUROPEAN SETTLEMENTS

Even before the railway reached the Highlands, a few bold adventurers had settled in the most favorable places along the route projected. Rapid settlement did not begin, however, until 1903–1904, and even then travelers along the most beaten highway might suddenly find themselves marching into a herd of elephants, which still roamed in this area. During the first few years the settlers needed machinery, breeding stock, seed, clothing, and other products for the development of plantations, but they had little to sell in return. As late as 1910, the exports from the Highlands were negligible except for hides and skins which were purchased from the natives. During the next decade the production of coffee and sisal increased rapidly, and since 1920 maize and wheat have become important crops.

## THE COFFEE-SISAL BELT

The alienated area situated within the southeastern part of the Highlands is primarily given to the production of coffee and sisal. In 1927, these two crops occupied 90 per cent of the total area planted in this district and were given practically the entire time and attention of the English settlers (Fig. 7).

### COFFEE THE MAJOR COMMERCIAL CROP

Almost immediately after settlement, coffee became the major commercial crop and has retained first

[8] Fraser, Donald. "The New Africa, 1928," p. 68.

position to the present time (Fig. 8). The cultivation of coffee is limited almost exclusively to European plantations. The natives are effectively prevented from growing it by the Coffee Plantation Registration Ordinance, which requires every coffee grower to secure an annual license costing 30 shillings.[9] Even if this sum were not prohibitive to the natives, the district commission can refuse to issue a license.

The coffee plantations are all situated between 4,000 and 7,000 feet in altitude, the best results being obtained between 5,000 and 6,000 feet (Figs. 9 and 10). The general tendency is for the lower altitudes to produce a heavy yield of low-quality coffee and the higher altitudes to produce a lighter yield of the better quality.[10] The area of most extensive cultivation and abundant production is situated on the southeastern border of the Kikuku Plateau (Figs. 1 and 8), at an altitude of 4,000 to 5,000 feet. It is near the Uganda Railway with but a short haul to the coast. The neighboring districts are densely populated, and provide many laborers. Yet, during the harvest season the local supply is insufficient to meet the needs of the coffee planters, and recruiting agents are sent among distant tribes to secure additional workers. In this way many married men are taken from the reserves for a protracted period of time. Their absence creates unsatisfactory social conditions which are detrimental to family life.[11]

Although the coffee planter frequently is handicapped by a shortage of labor, his greatest fear is that of a drought or other adverse weather conditions. During the dry seasons hot winds from the north quickly injure the crop. In order to reduce the exposure to these winds many of the plantations are situated on south-facing slopes. Throughout the Highlands hail storms are frequent and cause much damage, and on the higher elevations the crop is adversely affected by the low temperatures at night.

FIGURE 16.—The broad level uplands of Uasin Gishu are well adapted to the use of large-scale machinery. An American-made drill is being used in sowing wheat. (Courtesy of Foreign Crops Division, U. S. Dept. of Agr.)

The acreage yield of coffee varies from year to year (Fig. 11). Evidencing the truth of this is the following statement made by a resident of Kenya: "As long as I have lived in Kenya it has always been an abnormal year. In 1920, it rained in sheets; in 1921, my garden burnt to dust by the blazing sun; in 1923, we were marooned for weeks when floods and cloudbursts washed all our bridges away. Last year (1924) there was so little rain that people, who had budgeted on a hundred tons of coffee, found themselves in great disfavor with their bank

[9] Kenya Coffee Ordinance, 1918, p. 9.

[10] "Kenya, Its Industries, Trade, Sports, and Climate," Kenya Empire Exhibition Council, 1924, p. 58.

[11] Kenya Colony and Protectorate, Report of the Labor Commission, Nairobi, 1927, p. 32.

managers, and only fifty tons to sell." [12]

In spite of climatic handicaps and labor difficulties, the coffee industry has prospered and the acreage and production have increased. The undeveloped area suited to the crop is still large, but the increasing shortage of labor is likely to be an effective check to continued and rapid expansion.

FIGURE 17.—Picking tea within the western Highlands of Kenya. (Courtesy of Foreign Crops Division, U. S. Dept. of Agr.)

### SISAL

Sisal ranks second only to coffee as a commercial product of Kenya, and is the most reliable of the commercial crops of the Colony. It requires a tropical climate with moderate to light rainfall and can stand long periods of drought. During the year 1921–1922, when the rainfall was much below normal, injuring both the coffee and the maize crops, sisal did exceptionally well (Fig. 11).

Sisal is grown on the coast, along the Uganda Railway, and in the Highlands. The area of greatest production is near Fort Hall where the sisal industry vies with that of coffee for the labor of the densely populated Kikuyu Plateau.

Since Kenya has two growing seasons each year, the sisal plant grows more rapidly than in its original home—Yucatan. It also dies younger, but the number of leaves harvested from each plant before death is about the same in each country.

In the Lowlands the fields are not cultivated before planting. They are merely cleared of vegetation after which holes are dug for the bulbils. This method is adopted partly because of the difficulty of keeping oxen in the hot humid climate, and partly because the coral land of the coast does not lend itself to cultivation.

Within the Highlands the ground is thoroughly tilled in order that other crops such as maize, beans, or wheat may be cultivated along with the sisal during the first two years.

Sisal production is primarily a corporation industry. The manufacture — decortication — requires costly machinery; large expense is necessary to house and pay the laborers, and economic production requires the cultivation of several hundred acres—a plantation large enough to steadily supply a factory. Moreover, there is no financial return during the first two or three years. These conditions have effectively prevented native production of sisal. Thus, the two major crops

[12] Buxton, M. Aline. "Kenya Days." Arnold & Co., London, 1927, p. 78.

of Kenya are grown almost exclusively on the plantations of European settlers and under European management but by native labor (Fig. 12).

## THE CEREAL BELT

Cereal production is as dominant just west of the Great Rift Valley and within the northeastern part of the Highlands as coffee and sisal are within the southeastern part of the Highlands. In 1927, Nakuru, Uasin Gishu, and Trans Nzoia grew 88 per cent of the maize, 80 per cent of the wheat, and 78 per cent of the barley of Kenya. These three crops also occupied 89 per cent of the total area planted within these districts (Figs. 1 and 7).

Maize, which requires abundant moisture, is cultivated almost exclusively upon the Mau Plateau—the Highlands west of the Great Rift Valley. Wheat is grown primarily upon the Plateau, but excellent crops have been harvested within the Valley in spite of its light and uncertain rainfall. However, the Valley is primarily given to pasture. Mr. W. S. Bromhead, in writing of this area, says: "East of Nakuru (a city near the western margin of the Rift Valley) one gradually works out of the mixed-farming country and approaches the characteristic Marino sheep and rich fattening pasture lands of the Rift Valley." [13]

The distribution of cereals is not only related to rainfall but also to topography and transportation facilities. Between Nakuru and Uasin Gishu is a mountainous area which has but little land suited for cultivation, and it is still occupied by the natives. Farther north within Uasin Gishu and Trans Nzois are large plateau areas where the land is relatively level and where machinery can easily be used in large-scale crop production. Uasin Gishu is the foremost province in the use of modern machinery, where, in 1927, more than 500 tractors were in operation. The oxen, however, still do most of the heavy work (Figs. 14 and 15). In 1927, more than 50,000 of the 83,000 trained oxen of Kenya were found on the farms of Nakuru, Uasin Gishu, and Trans Nzoia, while but 7,000 were used in the coffee-sisal area of Kikuyu.

Because of the increasing use of large-scale machinery the cereal planters have not been seriously handicapped by the shortage of labor (Fig. 16); consequently, maize production is increasing more rapidly than that of any other crop (Fig. 13).

The most effective check to the rapid expansion of cereal production has been the lack of adequate transportation facilities and of conditioning plants to prepare the grain for shipment. Wheat and maize can not stand the cost of long hauls by oxen, nor can they be shipped long distances through the hot moist tropics without first being prepared for transit through such a climate. Several conditioning plants have now been erected to prepare maize for export. The one situated at Kilindini is the largest of its kind in the world. The purpose of the plant is to remove the excessive moisture in the corn and to kill the weevils and their eggs. If not so treated, the grain will rapidly deteriorate in transit and become unfit for use and even dangerous as a cargo. Prior to the erection of these plants, a load of maize being shipped to Europe had to be unloaded at Durban, South

[13] Bromhead, W. S. "What's What in Kenya Highlands," p. 60.

Africa, because of spontaneous combustion in the hold.

### THE MIXED-FARMING AREA

The southwestern part of the Highlands and the western slopes produce a variety of crops. Those listed in 1927, by the Agricultural Department of Kenya, were as follows: coffee, 13,700 acres; maize, 12,000 acres; sugar cane, 5,830 acres; tea, 2,430 acres; and wheat, 1,400 acres. Fruits, vegetables, and other crops are grown on a smaller scale.

The tea is grown at altitudes of 6,000 to 7,000 feet where the precipitation is heaviest and the humidity greatest. It is quite impossible, however, to rely upon the uncertain rainfall for tea cultivation. As a result the planter usually depends upon some artificial method of supplying moisture.

The problem of securing labor for the tea plantations is the chief difficulty to the expansion of the industry. The labor must be permanent as the plucking and manufacture of tea is continuous, which is not the case with coffee (Fig. 17).

The Highlands are well suited to the cultivation of sugar cane. There are two planting seasons each year; consequently, it is possible to have cane ready for the mill during the entire twelve months. The deep mud, however, makes it difficult to haul the cane from the fields during the rains and as a result most of the cane is harvested during the dry seasons.

### THE PASTORAL ZONE

The Great Rift Valley and the drier parts of the adjoining Highlands constitute the pastoral zone of the alienated lands. Most of the trained oxen are found in the cereal belt and the mixed-farming areas. Approximately 80 per cent of the cattle, other than the trained oxen, and 95 per cent of the sheep of Kenya are raised in this area (Fig. 7), representing a striking concentration of the animal industry within that part of the Highlands which has a rainfall of less than 40 inches.

# ECONOMIC ADJUSTMENTS IN BAVARIA[1]

*Hubert A. Bauer*

Associate in Geography, University of Washington

THE complexity of Germany's economic structure is in no small part due to the great diversity in the environmental elements which characterize the various political units of the German Republic. Among these units Bavaria, the southernmost of the German states, holds in more than one respect a singular position. Contrasts between north and south, although existing in many countries, seem to be accentuated in the case of Germany.

To the casual observer these contrasts might seem to be merely reflections of obvious physiographic and climatic differences, or again, they may appear to be caused by differences in soil, mineral resources, or location. These environmental factors are all active, but in Bavaria the type of population and the historical development are essentially different from those of the rest of Germany. An economic survey of Bavaria must, therefore, involve some consideration of the social and historical facts—indeed, some of its economic features would scarcely be intelligible unless traced back to their very beginnings in the dawn of European history.

While a general economic geography of Bavaria would seem to be chiefly concerned with a "horizontal" survey of the country, one must emphasize the "vertical" component in order to analyze and evaluate the position and significance of economic Bavaria as an integral part of economic Germany. However, this does not mean to take Bavaria out of the frame into which racial ties, recent history, and economic dependence have placed it. It would be a rather problematic piece of economic research if the general viewpoint of economic-geographic harmony, which controls any complex economic body of the nature and size of Germany, were to be omitted, for Bavaria represents a vital member of that body. That its economic branches have been able to spread and intergrow with those of the rest of Germany and of neighboring countries is largely due to the sound root-system which anchors it to a native vigorous soil.

## Environmental Considerations

Bavaria is continentally situated, Munich being about as far from Genoa as Nuremberg is from Hamburg. Its 29,000 square miles extend from the Alps in the south to the middle-German highlands in the north, from the limestone ridges of the Swabian Jura in the west to the forest-clad heights of the great eastern fault scarp known as the "Bohemian Forest." The Danube divides Bavaria roughly into a southern and a northern half. The true alpine section of the extreme south characterized by numerous northward sloping valleys sends a score of turbulent rivers towards the Danube across the Swabian-Bavarian Plateau, which adjoins the alpine section in a three-fold

[1] The author is indebted to the "Industrie- und Handelskammer" in Munich, Nuremberg, Ratisbon, and Wuerzburg, to the Bavarian Statistical Office in Munich, and to the Verkehrsverein, Munich and Wuerzburg for providing valuable material.

step-like arrangement. The southern third consists of the morainic undulating Alpine Foreland, a region of typical finger lakes; the middle section is a distinct belt of terminal moraines, through which the rivers have cut gorge-like valleys; where


FIGURE 1.—Location and physiographic divisions of Bavaria.

the gravel thins out, exposing the underlying triassic surface, the high water-table has caused extended marsh land, locally known as "Moos," most of which is cultivated today. The third step is formed by a broad hilly belt of triassic age, merging at the north into the valley of the Danube, the bed of which follows the broken rim of the down-sunken old-land block of the Vindelican Mountains.

There is, however, great contrast between the land north of the Danube and that of southern Bavaria. Here, the Jurassic period left its traces in the slaty chalk sediments of the Franconian Jura and in the sandy plains of Middle Franconia. The sandstone heights of the Spessart and Steigerwald, the volcanic ridge of the Rhoen and the southern tip of the Thuringian Forest, the Hass-Berge—all look down on the broad lowland of the winding Main, where the Muschelkalk and the Keuper of Triassic time have weathered into fertile soil. The topography of this region is furthermore varied by the frequent occurrence of dolomite, which constitutes almost exclusively the heights of the northern part of the Franconian Jura, the "Fraenkische Alp," one of the scenic jewels of Bavarian lands.

The entire northeast bears again the stamp of mountainous environment in the wooded hills of the Bavarian Forest and its northern extension, the Fichtelgebirge.

The Rhenish Palatinate, separated from Bavaria proper by parts of Baden and Hessen, like northern Bavaria reflects the control by the middle-German highlands. Like most of middle Germany, it shows marked physiographic contrasts. The broad expanse of the Rhine lowland, with its rich cover of loess, is bordered on the west by the Haardt Mountains, known for their vineyards; the more gentle western slope is forest-clad and breaks up into the wider, agriculturally used zone of the Westrich. The entire northern part of the Palatinate is an irregular, hilly country of low fertility.

Bavaria proper has a true continental climate, more pronounced in the south with typical Foehn in spring and frequent summer hail. The climate of northern Bavaria is somewhat modified due to general lower elevation and to greater topographic diversity. The Rhenish Palatinate, however, lying within the reach of maritime winds, enjoys a decidedly milder climate, which, in favoring the cultivation of wine and tobacco, represents one of its most valuable economic assets.

## HISTORICAL BACKGROUND

The greater part of these regions, both north and south of the Danube, have been in the hands of the Romans from 15 B.C. to about 450 A.D.; in fact, they constituted the Roman provinces, Noricum and Vindelicium. The American visitor, who enjoys the beauty of Bavarian scenery from his motor car, travels the same old Roman roads over which the famous legions of Varus tramped northward to meet defeat in the wilderness of the Teutoburger Forest. Many a Bavarian city has developed from an old Roman castellum and still bears its name, such as Augsburg from Augusta Vindelicorum, Kempten from Campodunum, and Nuremberg from the chief mart of Noricum.

Roman colonists were the first to clear parts of the dense forests; Roman enterprise, skill, and ingenuity first made use of the scanty mineral resources which Bavaria possesses—coal, iron, marble, and clay. Cleared lands and the raw materials obtained from them were utilized to supply the various Roman garrisons distributed over the country.

When the Roman legions were withdrawn about 450 A.D., many colonists and artisans remained, and their descendants mingled with the invading Boji (later Bajuvari), who migrated into the region from Bohemia about 520 A.D. These Bajuvari, roundheads of true alpine stock, were a peasant people with exclusively agricultural habits, a people to whom the economic division of life into agriculture and industry—even in the most primitive sense—was entirely unknown. Thus, it was primarily due to Roman influence that

FIGURE 2.—Typical morainic landscape southeast of Munich.

some of the clumsy, though diligent, Bajuvarian farmers changed from plow to artisan's tool, a step which may be considered as the real dawn of Bavarian industry.

Further historical development was chiefly the result of the spread of

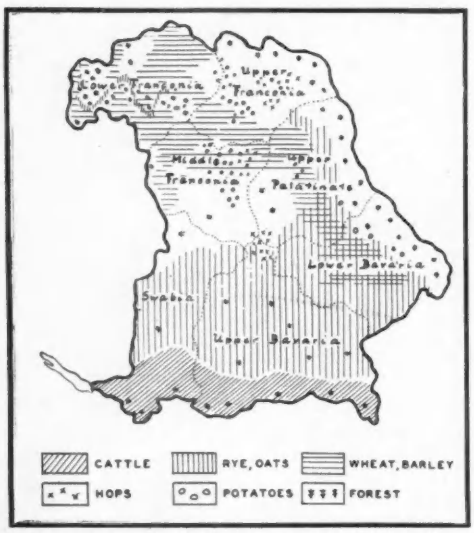



FIGURE 3.—Agricultural regions of Bavaria.

Christianity with its monastic organization, which, in response to its own economic needs and its program of colonization, continued the work of clearing land, improving agricultural methods, and providing the impulses towards more intensive industrialization. The art of brewing beer from barley and hop, which is still a typical Bavarian industry of respectable size, developed in the numerous Bavarian monasteries at the time of Charlemagne. As early as 768 A.D. Bavarian chronicle mentions the "hop-gardens" (*humularia*) of Freising near Munich.

A second stimulus was provided by the crusades after the year 1000. The crusades meant orientation and economic expansion towards the east, a thing greatly favored by the eastward course of the Danube. Goods from the Orient began to flow in, new contacts were made, new trades and arts were brought home from a successful crusade and, last but not least, the oriental method of trading with money was introduced. Cities like Ratisbon at the north bend of the Danube, or Passau, the frontier town, developed as centers of artisan trade due to their favorable location on this new east-west route, the Danube. Upon the growth of Venice and Genoa this east-west trade route lost some of its importance, for these city republics offered a faster water route to the Orient, a route of greater safety and one richer in new markets. Hence in the course of the thirteenth century a new north-south trade route was opened which in following the broad valley of the Inn led over the Brenner Pass and down the sunny valleys of the Eisack and Etsch to the prosperous world ports of the Adriatic and the Mediterranean Sea. These new contacts in turn gave rise to many new industries imported from Italy with its higher stage of industrial development. At that time the important art of manufacturing paper found its way to Bavaria, and in 1320 the first cotton bale came over the Alps to Ulm and Augsburg, bringing in its wake a new era of industrial progress. The ensuing rise of the Bavarian textile industry (chiefly linen and cotton mixed) approached modern capitalistic form even in the sixteenth century, when the family Fugger in Augsburg was known as the wealthiest patrician house in all Europe, lending money to kings and emperors. That other cities, particularly Nuremberg, also shared in this wave of prosperity may be inferred from a statement made by Pope Pius II that "the citizens of

Nuremberg live better than the kings of Scotland." This was a time when nearly every trade was ruled by strong artistic taste, when the artisan was an artist, when the masters of the trades constituted the prime of citizenship, often influential political leaders.

Between this first climax in Bavaria's economic history and the present day occurred, however, a long period of standstill and complete stagnation. The cause was again a shifting of trade-routes, this time the opening of oversea routes subsequent to the discovery of the Americas, and of the new sea route to India. Furthermore, the thirty years' war and other religious struggles like the Hussite invasions devastated Bavaria so completely that even the inland market was ruined for many years. Then came a short period of recovery followed by a second economic relapse, the result of the Napoleonic wars at the end of the eighteenth century.

Conservative by nature and severely handicapped by the antiquated guild-system, Bavarian industry was slow to introduce the mechanical processes which followed the invention of the steam engine. Relatively late (1837) the first mechanical weaving loom was installed; in 1835 the first experimental railway was built between Nuremberg and Fuerth, but other lines followed then in rapid succession. This marked not only the beginning of the new era of industrialization, but also a closer trade-contact with the rest of Germany, new markets for Bavaria's surplus and a more accessible supply of much-needed raw materials and mineral fuel.

This period should also be associated with three outstanding rulers, King Ludwig I, Maximilian II, and Ludwig II, all of which immortalized their love of art and science in a surprising number of beautiful structures, of valuable collections, and of scientific institutions, thus promoting the natural artistic leaning of the Bavarians and stimulating a series of subsequent industries, which otherwise would never have developed to such proportions as they did.

Bavaria's admission as a federal state into the German empire in 1871, an event which crowned Bismarck's work, was of great economic significance, for it linked Bavaria to the world markets. As a member of the German empire, Bavaria, in contrast to other members, succeeded in reserving various privileges, the most important of which was state-independence of railroads and mail. With southern pride and inherited stubbornness Bavaria anxiously watched and fought for the continuance of these reservations; for behind pride and stubbornness were strong economic reasons, which controlled this "particularism" of the southern confederate.

This brief historical outline may serve to explain in part those economic adjustments in Bavaria, for which environmental causes seem to be inadequate.

## ADJUSTMENT TO SOIL

The outstanding economic adjustment in Bavaria is to soil. Agriculture has been the backbone of Bavaria's economic life ever since the first Bajuvarian farmer turned the first sod with primitive plow. The predominance of agricultural adjustment is not only reflected in the number of people engaged in agricultural pursuits; it is also shown

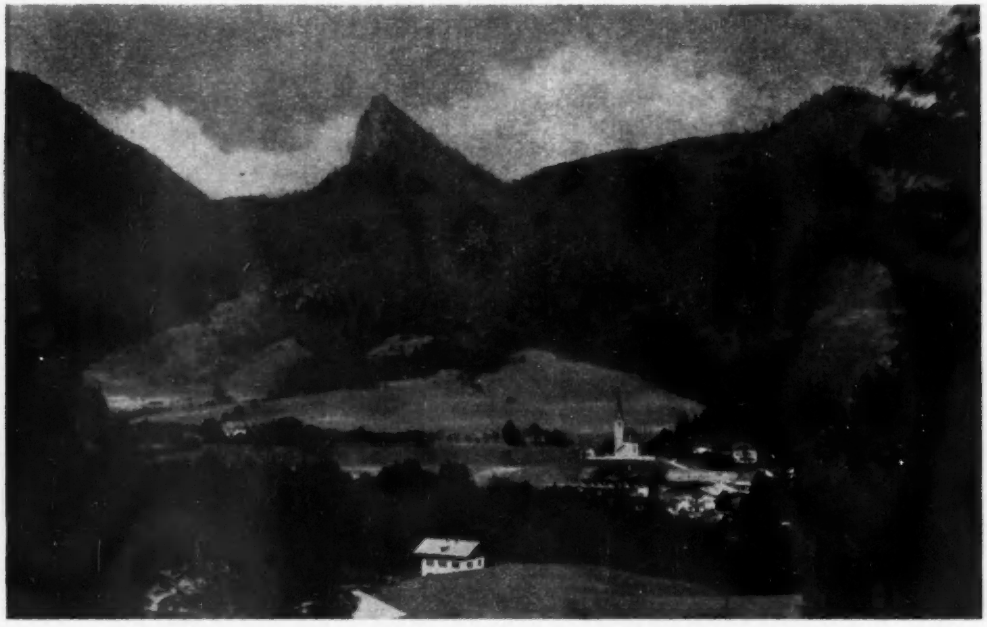


FIGURE 4.—Alpine Forest and Dairy Region, Dorf Kreuth, near Tegernsee.

in a relatively large contribution to Germany's food supply, which approximates 25 per cent. Bavaria's share in Germany's total agricultural production was in 1925 as follows:[2]

| | *Per Cent* |
|---|---|
| Wheat | 6.4 |
| Rye | 9.2 |
| Barley and oats | 17.5 |
| Potatoes | 11.8 |
| Hops | 81.3 |
| Wine | 27.7 |
| Dairy products } Beef cattle } | 20.7 |

The areal distribution of these products as exhibited by Figure 3 follows, of course, closely the qualitative distribution of soil.

## AGRICULTURAL CROPS

The stock raising and dairy industry is concentrated in the Mountain Region and the Alpine Foreland, where as in Switzerland and the French Alps an intensive use of the summer-pastures of the "alp" is made. The cattle and dairy farmers of the mountain valleys coöperate successfully in so-called "Weidegenossenschaften" (pasture-associations). The alluvial plain of the eastern Danube, comprising most of Lower Bavaria with some loessal soils, is called the "Kornkammer" (grain-chamber) of Bavaria; this region is a pronounced surplus district for wheat and barley. Oats and rye, crops which are especially adapted to Bavaria's harsh continental climate, are practically grown in all agricultural regions for local needs. The same is true for potatoes, but the sandy soils of Middle and Lower Franconia produce the largest quantities and the best qualities. Hops, an important product in a country where beer is considered a valuable contribution to food supply and where brewing is, therefore, a tradition, is restricted to smaller areas of rich soil, such as found near Ingolstadt on the Danube and about Spalt and Erlangen, regions also noted for

[2] Dr. Fr. Zahn, *Bayern und die Reichseinheit.* 2. Aufl., Muenchen, 1925.

tobacco. Nuremberg and Bamberg are the outstanding centers of the hop-trade. Wine is the money crop along the course of the lower Main, chiefly grown on the southern slopes between Schweinfurth and Wuerzburg in Lower Franconia, where the terraced landscape is not unlike that of the Rhine and the Moselle. Another noted wine region is the eastern escarpment of the Haardt in Rhenish Palatinate; second to wine is tobacco in this latter region; early tobacco-growing has given rise to an important tobacco-working industry, which has long since outgrown the local supply depending to a large part upon the better qualities of oversea tobacco.

### DAIRYING

Outstanding in quantity and quality among agricultural commodities are the dairy products of the Alpine Region, especially those from the southwestern part known as the "Allgau." Allgau cheese and butter are scarcely inferior to the neighboring Swiss products although not so widely known. Coöperative organization similar to that in Denmark is largely responsible for the economic success of this dairy region. The cheese and butter exchange in Kempten controls the entire Bavarian market. Fresh milk is shipped from the Allgau as far as Nuremberg. It is economically significant that the same region is also noted for its manufacture of parchment paper as used for wrapping butter and cheese. The value of dairy production amounted in 1924 to 29.5 million dollars as compared to the combined production of bread grain (wheat, barley, rye), which in the same year was valued at 71.5 million dollars.

### *Agricultural Organization*

In contrast to northeast Germany, Bavaria is a country of small farmers. Bavarian agriculture is characterized by a great predominance of homestead farming; the family-owned farm, the "Bauerngut," handed from father to son, is the rule. As much as 94.5 per cent of all agricultural land is owned by the farmers, and two-thirds of all farms are homesteads.

Of the total of 666,000 farms, over one-half are small farms (1 to 12 acres); over one-third are middle-sized farms (13 to 50 acres); about one-twentieth are larger-sized farms (51 to 250 acres); and only 548 farms are holdings over 250 acres. The middle-sized farm forms the backbone of agricultural life in Bavaria. This size of farm is associated with that special type of hereditary farmer who determines the social and political particularity of the country. Rooted to the soil, loyal, hardworking, healthy, simple, and conservative in his habits, he is nevertheless friendly to progress. This is also true in some measure of the holders of smaller and larger farms.

Due to the abundance and early development of waterpower in southern Bavaria, practically all farms enjoy the advantage of electric light and to a lesser extent of power. The modern need for coöperative organization is widely recognized and appreciated. This type of organization included in 1927:[3]

1,004 Productive Associations (including sale)
549 Work Associations (chiefly for plowing and threshing)
103 Cattle Breeding Associations
190 Buying Associations (seeds and fertilizer)

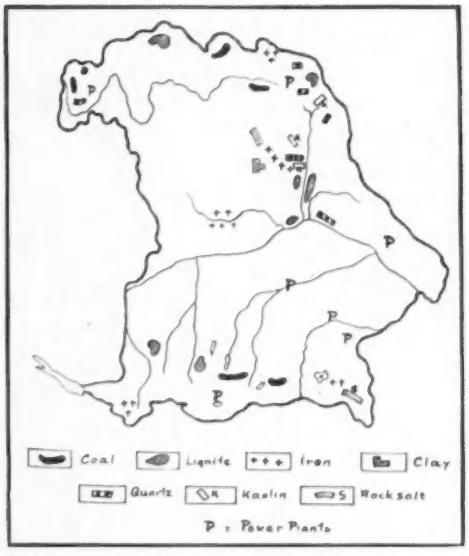



FIGURE 5.—Mineral resources and water power in Bavaria.

108 Warehouse Associations
4,920 Credit Associations

Most of these coöperative associations are organized in seven central bodies, "Zentralgenossenschaften," who represent a factor of great power in the economic and political life of the country.

*Government Aid to Agriculture*

The government, in which the farmers are well represented, spends annually considerable sums (in 1926 some 8 million dollars) for the advancement of agriculture, by operating the following institutions:[3]

1 Agricultural College (connected with brewery-school)
1 Forestry Academy
1 Veterinary College
88 Agricultural Schools
17 Agricultural Household Schools for Women
4 Schools for Garden Fruit- and Wine-Culture
3 Seminars for Agricultural Teachers
98 Agricultural Service- and Advice-Stations
1 Chemical Institute for Soil Analysis and Soil Improvement
1 Biological Institute for Fish Culture
A System of Winter- and Travel-Schools
A System of Offices for Soil Culture
Several model farms
An experiment station for moorland cultivation

These state institutions are supplemented by numerous private organizations, especially such concerned with the raising of small animals like fowl, goats, and sheep, or with vegetable-, fruit- and bee-culture.

FORESTRY

The importance of Bavaria as a wood grower is best shown by a comparison with the British Isles, where the proportion of wood area to population is somewhat less than 8 acres to every 100 persons. The Bavarian proportion is 95 acres to every 100 persons, considerably exceeding the ratio for self-supply which is estimated to be 85 acres to every 100 persons.[4]

Bavaria has a total forested area of 7 million acres, of which 2½ million acres are state forests; 1¼ million acres are community-owned forests; and 3¼ million acres are private forests. That these 3¼ million acres of private forests are owned by farmers, not by private capital, is of great economic importance to all parties concerned: the farmers, the country, and the forests.

[3] *Statistisches Jahrbuch fuer den Freistaat Bayern, 1928.* Published by the "Bayerisches Statistisches Landesamt," Muenchen, 1928.

[4] Lyde, Lionel W., *The Continent of Europe.* Macmillan & Co., Ltd., London, 1926.

The areal distribution and the types of forests reflect closely topography and soil. That the names of many Bavarian hill regions are ending in "wald" (= forest) is not only suggestive to a former heavy timber-cover of these regions, the names continue to be appropriate also at the present time, thanks to wise use and systematic reforestation.

A heavy stand of fir and pine covers the north slopes of the Bavarian Alps, but the timberline extends hardly beyond 5,000 feet. The morainic Alpine Foreland has a more park-like growth of conifers, largely owned by farmers and communities; the more extended forests of this region are state-owned, well kept, continuously reforested, and are housing considerable numbers of game. The river courses are fringed with that typical mixture of conifers and leaf trees (beech) which render the riverine land so colorful in spring and fall. Birch is the tree characteristic to the marshy stretches fringing the outwash plain, while thin stands of scotch fir are the only forests thriving upon the sandy soils of middle Franconia, especially around Nuremberg. Beech and oak, with the former prevailing, cover parts of the Franconian Jura, stand and quality increasing towards the north, but both comparatively poor due to the quick loss of moisture in the porous chalk. One of the largest uninterrupted areas of dense forests (fir and pine) is represented by the Bavarian Forest and the Fichtelgebirge, the latter name revealing the predominant species (Fichte = pine). Upper Franconia, which includes the Fichtelgebirge and the Frankenwald to the west of it, boasts not only of the most beautiful beech-woods in Bavaria, but also of the highest percentage of forest-area 35.5 per cent as compared with 40.8 per cent of agriculturally used land. Another veritable green sea of chiefly deciduous forests present the Steigerwald and the Spessart, the latter famous for the best quality of commercial timber, including a heavy stand of oak. Strikingly bare of forests are the heights along the middle course of the Main, where wine is grown, and the volcanic soils of the Rhoen to the north of it, a reason that the latter has become the most popular training field for German "gliders."

Closely associated with forestry in Bavaria is the protection and keeping of game. The economic importance of this phase of forestry may best be shown by some figures taken from the statistical yearbook of the Freestate Bavaria for 1928. The total number of game killed by licensed hunters during the year 1928 amounted to 459,369, including stag, deer, hare, wild boar, and chamois, also 250,447 wild fowl, and 72,111 predatory animals, altogether valued at about one million dollars.

In reviewing Bavaria's adjustment to soil it may well be said that the country is making intensive use of its relatively poor soils and unfavorable topography. Three factors appear to be responsible for the high standard of agriculture (including dairy farming and forestry): a sturdy and diligent type of hereditary farmer, the intensive use of high-grade and cheap fertilizer, and the aid and wise guidance by an agriculturally minded government. The shortage in certain products like in wheat, barley, rye, and swine is almost balanced by a considerable surplus in other products of the soil, such as oats, hops, potatoes, beets, hay, straw, dairy and forest products, and beef-cattle.

### INDUSTRIAL ADJUSTMENTS

Bavarian industries, though most of them are small when compared with the gigantic industrial centers of the Rhine and Ruhr or with those of Saxony, are by no means negligible.

FIGURE 6.—Products of Selb, the city of porcelain.

Some of them have increased in size and have become indispensable pillars in the huge structure of Germany's industrial life, thus contributing their modest share to the world's needs. Bavarian statistics reveal surprising numbers of industrial plants of almost every description and size; the whole country, small as it is, buzzes with a very diversified industrial activity. It is this diversity in industrial adjustments which requires careful analysis, in order that the soundness of Bavaria's industrial life may be justly appraised and clearly understood.

As in móst countries of the old world, a great number of industries had their beginnings in the artisan's workshop, and their development was primarily due to the spirit of enterprise on the part of some skilled master. Such types of industrial development may hence be called "accidental," unless the development has been favored by one or more of the locative factors of industry. There are some fifty different classes of goods manufactured in Bavaria, and the number of different commodities runs far into the thousands. In the face of this variety of industrial activity it would appear that some attempt at an industrio-geographic analysis would be desirable. By this plan a double result should be achieved: (1) an environmental grouping of the industries; and (2) a clear comprehension of the casual interdependence of economic activity and environment, both taken in their widest sense. The headings chosen for the following paragraphs suggest the chief locating factors.

### LAND UTILIZATION

With the exception of the southern pasture-lands and the various pronounced forest sections, bread grains are grown everywhere. Numerous flour mills are, therefore, distributed all over these agricultural districts, ranging from the modest old type mill, sufficient for local needs, to the gigantic modern milling plant supplying the populous urban centers. The latter type, though originally located in the south with its rich water-power sources is, however, now to be found wherever the need for them has arisen, for electric power has recently been transmitted over the whole country.

The still important, though declining, brewing industry follows the distribution of hops and barley, a correlation which is indicated by the famous beer brands of Munich, Nuremberg, and Kulmbach. In the case of Munich beer it is interesting to note that the quality of the water and even that of the atmosphere plays a part, since scientific tests have proved that equal aroma and flavor cannot be ob-

tained in any other locality. Associated with beer production is that of malt and malt-products, also the manufacture of brewing machines with Munich as the chief center. Munich and Nuremberg, lying as they do adjacent to important agricultural areas are the natural centers for the manufacture of agricultural machines and implements.

In response to the abundance of forests there are about 1,500 sawmills throughout Bavaria, chiefly in the south, in the Bavarian Forest and in the Spessart region, where the most valuable timber is obtained. The same regional distribution holds true for the paper industry. In the south, due to greater water-power resources, there is a numerical predominance of paper mills, although the largest plant is that at Aschaffenburg, the Main-city controlling the Spessart region.

As has been mentioned under "adjustment to soil," most of the agricultural land of southern Bavaria is in pasture, thus giving way to a well-concentrated stock-raising and dairy industry, the former all over Upper Bavaria and Swabia, the latter attaining its most intensive development in the southern part of Swabia towards Lake Constance.

### MINERALS

Many writers refer to Bavaria as a country noted for its *entire* lack of coal and other minerals. It may then be surprising that Bavarian statistics for the year 1927 show 4 anthracite mines, 25 bituminous and lignite coal mines, and 76 iron-ore mines, with a total employment of 8,633 miners and an output of almost 3 million tons (valued at $7,000,000). The mineral *wealth* is almost entirely confined to the Upper Palatinate[5] and to Upper Franconia, some coal and rock-salt occurring, however, in small quantities along the piedmont of Upper Bavaria. Iron is of some importance at Amberg where blast-furnaces are in operation. The Upper Palatinate and Upper Franconia, lying along the fracture of the old crystalline core, are rich in granites and basalts, in feldspar, quartz, marble, and slate; also, in kaolin and clays. The porcelain industry of this region includes some 50 plants, some of them employing as many as 2,500 workers. Selb, the "porcelain city," is the home of the famous "Rosenthal" brand, noted for its artistic design and shipped all over the world. The manufacture of glass is also localized in the northeast, particularly in the Fichtelgebirge, but also in parts of the Bavarian Forest and of the Spessart. The industry employs about 15,000 workers and supports more than 100 establishments in Nuremberg and Fuerth, cities which specialize in plate glass, mirrors, and other finished glass wares.

How old the glass industry in these quiet forest-valleys is, and what share history has had in the economic development of the region, is well illustrated by the glass-pearl industry of the Fichtelgebirge. Protoberas, a dark green mineral of the "hornblende" group, attracted the primitive glassmakers at an early period by its superior fusibility and its fitness for the manufacture of glass beads. These pearls, as they were called, became so much in demand as barter articles or economic tokens, that during the time of the Crusades they spread over the Balkan countries into Asia Minor and even to

[5] Sometimes called the "Steinpfalz" (Stein = rock, pfalz = Palatinate) in phonetic imitation of "Rheinpfalz" (Rhenish Palatinate).

Persia. When the trade route over the Brenner opened, the Fichtelberger beads flowed into Africa by way of Venice and Genoa, and it may well be assumed that Columbus carried them on the Santa Maria into the West Indies. Today they are found in the necklace of many a South Sea beauty as well as in the rosaries of pious Mexican nuns—a unique fact of economic geography. At the present time glass pearls continue to be a specialty of the region, and the industry is still leading its fairy existence in the dreamy valleys of the Fichtel. Its only change has been the adjustment to the demands of an ever-changing style on the world markets through the application of the inherited skill and diligence of its thousands of home workers to a greater variety of products.

The Franconian Jura as a limestone formation is noted for its numerous lime-furnaces, as well as for its quarries of lithographic plates near Solenhofen, a place well known to the paleontologist for its abundance of Jurassic fossils. Brick yards, numbering over 500, are widely distributed, but most numerous in the vicinity of Munich, which furnishes a large consuming market. The pottery and chamotte works are chiefly located in the Upper Palatinate (around Schwandorf) and near Coburg in the extreme north.

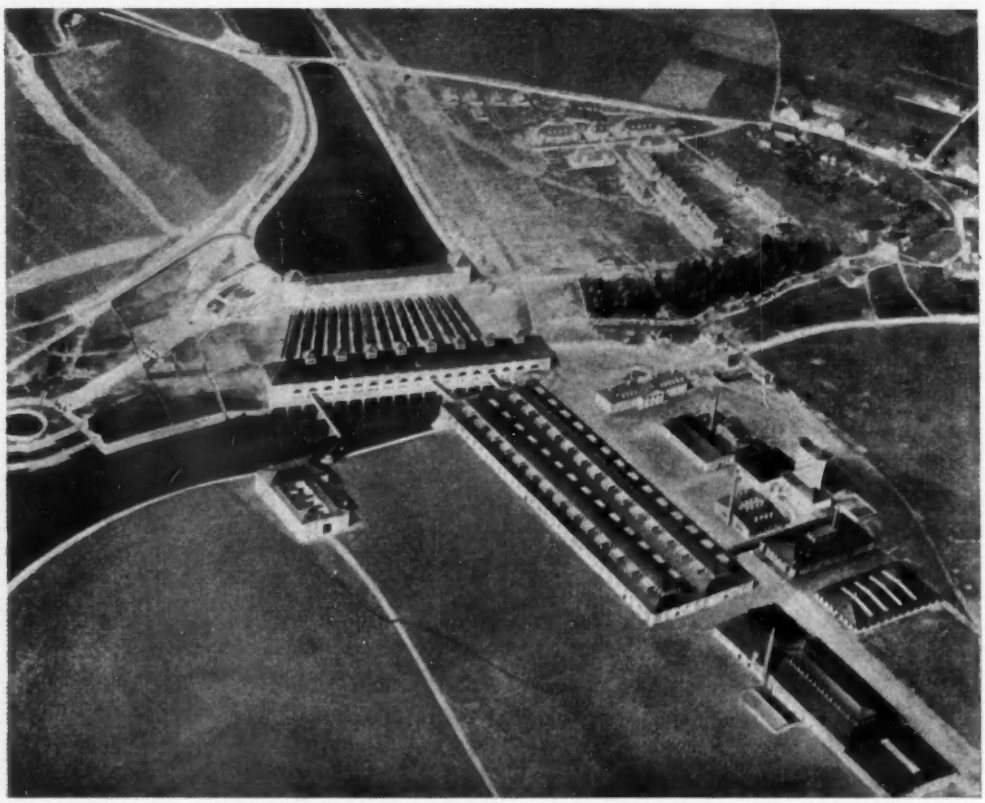


FIGURE 7.—The "Innwerk" near Muehldorf on the Inn. Power and Aluminum Plant.

Lyde, the British geographer, ascribes the location of the important lead pencil industry of Nuremberg to

the occurrence of graphite near Passau. These graphite deposits are, however, insignificant in quantity and of a quality which would hardly justify the world reputation of Nuremberg pencils. The graphite deposits, from which the Faber factories draw their supply, are located in the cellars of the Faber plants. Many hundreds of tons of this unexcelled graphite have been mined in Siberia some fifty years ago by Lothar von Faber and brought to Nuremberg, a supply which is estimated to last at least another hundred years.

### WATER POWER

The development of water power is the most recent chapter in the economic history of Bavaria, and the chapter of greatest importance. The process of power generation itself concerns only a comparatively small number of persons (8,000 at the present time), but the new industrial revolution, brought about by the post-war establishment of huge power projects, affects practically the whole economic life of the country. The manufacture of electric materials, the installation of power service, and other subsequent lines of activity have increased on a scale hardly equalled by any other country of this size. Existing industries have expanded, and a great number of new industries have sprung up in regions which never dreamed of such industrial possibilities.

The numerous mountain lakes and the rapidly flowing rivers of the Alpine Foreland represent a potential power of over 2 million H.P. of which 939,000 are already developed. While thousands of small plants created by private or communal enterprise had already existed before the war, the last decade has been so marked by the development of a series of well-planned state projects, that the electrification of Bavaria is rapidly becoming a reality. Bavaria's developed water power is distributed as follows:[6]

| *Horse Power* | *South Bavaria* | *North Bavaria* | *Total Horse Power* |
|---|---|---|---|
| Under 150 | Approximately | 11,700 | 173,000 |
| Over 150 | 130 | 70 | 766,000 |
| Over 1,500 | 38 | 10 | 635,000 |
| Over 10,000 | 11 | .. | 590,000 |

These power plants serve the following industries and purposes:

| *Purpose* | *No. of Plants* | *Horse Power* | *Per Cent* |
|---|---|---|---|
| Electric light and railroads | 969 | 533,000 | 56.7 |
| Electro-metallurgical and chemical | 8 | 185,000 | 19.7 |
| Saw mills, flour mills, farms | 8,197 | 105,000 | 11.1 |
| Paper mills and associated industries | 146 | 38,000 | 4.1 |
| Textile industry | 134 | 37,000 | 4.0 |
| Not classified (workshops) | 2,487 | 42,000 | 4.4 |

This table shows clearly that water power is the chief locating factor for the metallurgical, chemical, and textile industry. A comparison of the different industrial groups which use water power reveals the enormous consumption of electrical energy in metallurgical and chemical plants. A single plant of that group, the aluminum works of Toeging on the Inn (Fig. 7) consumes one-half of the 100,000 H.P. produced by its power plant, the "Innwerk," while the other half serves a variety of purposes. The output of the plant in aluminum amounts at the present time to 12,000 tons annually. Another important industrial plant at Tacherting, built upon the water power of the Alz, a tributary of the Inn, uses the entire energy of its 40,000 H.P. for the manufacture of more than 30 important chemical compounds. These are but a few selected examples which illustrate the rise of new in-

[6] Huebschmann, K., "Die Entwickelung der Wasserkraftausnuetzung in Bayern," Article in Kuhlo "Geschichte der bayerischen Industrie," Munich, 1926.

dustries in an otherwise industrially poor region.

The cotton textile industry has, of course, always been located by cheap power, and cotton spinning is, therefore, to be found in many mountain valleys of southern Bavaria, especially in Swabia (Fig. 8), where Augsburg, Kempten, and Sonthofen are the chief centers. The north-Bavarian textile industry, also of the so-called "leonic" industry, the spinning of gold and silver threads and laces. Both textile centers, the Swabian and the Franconian, represent a total of over two million spindles.

### CHEAP LABOR

Cheap labor is in many cases a result of dense population. Again, it may in some cases be associated

FIGURE 8.—Cotton spinning plants in the Allgau.

chiefly cotton, is only in part located by water power; in many cases there are other nearby sources of energy, such as the lignite deposits of Czechoslovakia and Saxony, responsible for the development which followed the industrial revolution around the middle of the nineteenth century. The chief spinning centers of northern Bavaria are Nuremberg, Fuerth, Bamberg, Hof, Kulmbach, Forchheim, and a great many still smaller places, some of which specialize in products with less dense population but poor soil, though the latter association is far from being an economic law, as the example of the Po basin—good land and cheap labor—shows. Yet, in Bavaria, where the population density is somewhat less than 250 per square mile as compared with almost 350 for the "Reich," there are distinct regions, where poor soil is undoubtedly the chief locating factor for typical industries of the cheap-labor kind. The toy industry

of northern Bavaria with Nuremberg as collecting center is one of them. Toys are made in the poor valleys of the Fichtelgebirge and around Coburg. The latter region specializes also in basket weaving; not less than 2,731 small concerns who manufacture wicker ware live in the towns and villages around Lichtenfels and Coburg.

Another region of poor soil is the Spessart. Aschaffenburg, the chief city in that region, has developed an enormous clothing industry; 40 factories keep a score of tailor-villages busy in the adjacent valleys of the Spessart and the Odenwald, where 7,000 people working in self-organized village groups enjoy a fairly prosperous though busy existence. Though the origin of this clothing industry must be classified as accidental, its development to the present state was decidedly favored by a rural population living on poor soil.

On the other hand, Bavaria also offers an excellent illustration for the existence of a cheap-labor home industry in a prosperous dairy region. The town and district of Lindenberg in the Allgau near Lake Constance is known for its straw hat industry, which is of more than one hundred years' standing. Old records of the region show that as early as 1815, at the close of the Napoleonic wars, 356 families were engaged in straw hat manufacture, the output of that particular year amounting to about 56,000 hats. The wheat-straw used was imported from Italy or supplied by the Black Forest region. The nearness of sunny Italy was certainly one of the primary impulses which started this home industry. The increasing mechanization of the manufacturing process, the invention of the sewing machine and of the hydraulic press brought a change in factory methods. Bleaching and dyeing plants sprang up as auxiliaries; leather, hat-band, and lining factories followed; and finally, a cardboard-plant was added to supply the containers for shipping the finished product of this well-organized industry. One should expect, then, that the original home industry was entirely replaced by these modern factory methods; more so since the Allgau had, toward the end of the last century, developed into a prosperous dairy region; but, up to the present day, a small army of nearly 4,000 women and girls still takes care of the sewing and outfitting as in the household stage of the past. The industry was highly stimulated by the acquisition of Kiaochow by Germany in 1896. This meant a direct and therefore cheaper supply of Chinese straw braid, a commodity which had replaced the European supply but had, up to that time, been exclusively controlled by the London market.

### PERPETUATED SKILL AND ART

Industrial occupations a hundred and more years old, such as the glass industry, the toy-making industry, the basket weaving of northern Bavaria, or the sheet-gold industry of Fuerth, may, of course, be attributed to the influence of inherited skill as a locating factor, although their origin was certainly due to other causes. The people of the old Bavarian stock, living as they do in the seclusion of their mountain valleys of Upper Bavaria, show an even greater disposition for inheritance of certain gifts, such as a marked leaning towards art in many forms. Music, wood-carving, and folk-play

are the most outstanding of these artistic traits. Some of these rural crafts, but not all of them by any means, have acquired a volume which almost justifies the use of the word "industry," though in a modest sense.

Of outstanding importance is Mittenwald, the town of violin makers and wood-carvers at the foot of the Karwendel, a town of scarcely 1,000 inhabitants. The art of violin making came to Mittenwald from Italy[7] as early as 1653 and persisted there as a tradition. Although the industry is declining, there are still some 250 violin makers in Mittenwald, who continue to operate their modest workshops without ceasing to be fairly prosperous livestock farmers at the same time.

Other villages in the Bavarian Alps, such as Garmisch at the foot of Germany's highest peak, the Zugspitze, specialize in wood carving; in addition Garmisch is a famous winter resort. Still better known is Oberammergau, which enjoys a world reputation with its "Passion Play." This little place developed its traditional play to such an extent that it has long been the mecca of tourists, drawing some 100,000 visitors every ten years. Although not an industry, this is an adjustment of rare kind, an adjustment which is also undoubtedly economic when measured on the modest scale of these simple mountaineers.

The very important art products industry of Munich is another economic adjustment to the artistic atmosphere of Bavaria, particularly to that of its capital city (Munich) with its wealth of art collections, old castles, and famous churches. This industry includes the hundreds of large and small factories and workshops for metal, wood, and ceramic work; it includes also an extended graphic industry with 780 printing establishments and lithographic studios.

[7] Mittenwald is located at the northern end of Seefeld Pass which is the shortest approach to the Brenner Pass.

FIGURE 9.—Alpine Pasture. The highest German peak, the "Zugspitze" (10,600 feet) in the background.

## SCIENCE

A locating factor, science, may appear unusual; and yet, it is chiefly the early development of Bavarian universities and "Technische Hochschulen" which together with their high standard of scientific research is responsible for the large number of plants concerned with the manufacture of scientific instruments. Instruments of precision mechanics, optical goods, medical instruments, and surgical equipment are Bavarian specialties. The names of Frauenhofer (optician), Steinheil (telephone), Roentgen and Linde (physicists), Liebig and Bayer (chemists) are intimately associated with this type of economic adjustment. That Bavaria boasts of the largest chemical plant of the world, the "Badische Anilin and Soda Fabrik" in Ludwigshafen on the Rhine (Rhenish Palatinate), is not a pure Bavarian achievement,

since it is more accidentally that this huge plant was transferred from Mannheim to its present location. Bavaria proper has a few hundred chemical plants which manufacture chemical products of the widest range, especially dyes, paints, and fertilizers; Heufeld near Munich is one of the large war-grown nitrogen plants so important to German agriculture.

### POLITICS

Even after its entrance into the German empire of 1871, Bavaria retained, in contrast to the rest of German federal states, a few special privileges, one of them being the authority to operate her own railways. This state independence in fighting the centralization principle of Berlin stimulated an important industry which had developed in Munich, the manufacture of locomotives and of railroad cars with a score of subsequent plants, of which two factories for roller-bearings in Schweinfurth are of particular importance. The two large locomotive plants in Munich employ from 2,000 to 3,000 workmen.

It was but a step from the manufacture of locomotives to the making of machinery of any kind, and consequently there developed a large Bavarian machine industry, which has in recent years assumed the lead in Germany. The "Maschinenfabrik Augsburg-Nürnberg" holds a world reputation for gas-engines, especially for diesel motors: most of the diesels for the war-submarines were manufactured in its plants.

### RELIGION

The devotedness of a large part of the Bavarian people to the Catholic creed is so pronounced that religion must be considered as a locating factor for at least a few of Bavarian industries. For example, the wholesale use of wax candles in the Catholic church requires a veritable army of wax manufacturers. The "Wachszieher" is one of the traditional trades found in almost every Bavarian town. The making of stained glass for church windows, the manufacture of church utensils for the ritual of Catholic church service, and finally the exclusive printing establishments for religious art constitute in fact, a regular "catholic industry."

The "Passion Play" at Oberammergau which brings such tourist wealth to Bavaria is in itself a testimony to the reality of religion as a factor in the national life. In no country save Bavaria would such a super-drama even be possible.

### SCENERY

Bavaria is noted for its scenic beauty, and, unlike other tourist countries, it offers satisfaction to the most diverse tastes. It combines the romantic beauty of Swiss alpine scenery with the subtle charm of the English Lake District, the quaint arcaded streets of Italian towns with the broad boulevards of modern cities, the art of Paris, Copenhagen, or Dresden with the bustle of the Ruhr, the medicinal springs of a Carlsbad with the snow of a Norwegian winter.

Bavarian scenery, Bavarian art, and—perhaps—Bavarian beer are the elements of the country's attractiveness and hence the locating factors for its tourist industry. In 1927 the hotels and hostelries in cities and rural resorts reported a total patronage of nearly 4 million visitors, a figure which may serve better than anything else to indicate the economic

value of this important industry. The Alpine Foreland, especially Munich as the physical and intellectual focus of the tourist trade, has undoubtedly made the closest adjustment to this environmental factor, while northern Bavaria with Old Nuremberg, the medieval Rothenburg, and the Wagner-city, Bayreuth, heading the list, is second.

## LOCATION AND IMPORTANCE OF URBAN CENTERS

As in many other countries there is also in Bavaria a slow but steady increase of urban population as compared with that of the rural districts. Classifying places with a population over 2,000 as "urban," the distribution of urban and rural life shows the following trend:[8]

| | *1910* | *1925* |
|---|---|---|
| Rural population | 3,800,179 | 3,816,386 |
| Urban population | 3,082,058 | 3,563,208 |
| Per cent—rural population | 55.2 | 51.7 |
| Per cent—urban population | 44.8 | 48.3 |

In spite of this apparent tendency toward urban predominance, the fair balance of the present distribution seems to reflect a likewise fair degree of economic harmony.

The few larger cities of Bavaria, representing the necessary concentrations of economic progress, indicate, by their very location and size, a sound economic development based on a well-proportioned adjustment to the natural regions which they control.

All these urban centers are old, and their origin and early development reaching back into early post-Roman time was, therefore, primarily dictated by strategic reasons. But, of the considerable number of old strongholds and strategic points, only those which came up to the requirements of economic strategy could expect to survive.

[8] From "Heft 116 der Beitraege zur Statistik Bayerns." Munich, 1928.

FIGURE 10.—"Neuschwanstein," one of the beauty spots of the Bavarian Alps.

Munich (the original name "Monachia" reveals it as an early monastic settlement) controlled not only the Brenner route, but also the old salt road leading from the southern rock-salt region around Salzburg to the north. Located, besides, on the "Isara rapida," a river on which raft-floating is a tradition, the city was and still is the chief gate to the southern timber region. In 1927, 2,819 timber rafts arrived in Munich. With the coming of the railroad, Munich rapidly became the economic center of the country, as well as its financial and political leader.

The city houses an astonishing variety of industries, specific trades, the ever-congested condition of its central station (one of the largest units in Germany)—all bear testimony of the large commerce which passes through and radiates from Munich.

Augsburg, only one railroad hour from the capital and in a river-location very similar to that of Munich, is, in spite of its old and mighty textile and metal-working industries, a city of modest size, limited in every respect by its very nearness to the capital. Both cities reflect the Highland control: Munich the old-Bavarian part, Augsburg the Alemannian part; both cities are likewise favored by recent water-power development. The Lowland is represented by three urban centers: Ratisbon, Nuremberg, and Wuerzburg, each having a special economic function.

Ratisbon owes its economic significance almost entirely to its location at the northermost bend of the Danube. Its recent economic growth is to be associated with the extension of the Danube navigation, which made Ratisbon its western terminus. The river-commerce passing through Ratisbon's small but modern port amounted in 1927 to 529,260 weight tons, carried in some 1,500 boats of 600 to 1,000 tons capacity. The export of 278,597 tons consisted chiefly of metal wares, machinery, salt, flour, chemicals, and tanning material, while the import of 250,423 tons was made up of only three large items: Hungarian maize, Rumanian wheat, and Rumanian mineral oil.

Nuremberg's economic importance reaches far back into the Middle Ages. Its early development was favored by a typical plains-location at the junction of two important trade routes, the alpine N-S route and the E-W route from Frankfort to Ratisbon. At the present time, with a population of little more than half that of Munich, it employs (together with its sister-city Fuerth) 90,000 industrial workers, the same number as the capital. The industrialization of the Franconian metropolis is, therefore, far more advanced than that of Munich. It is again due to location that its economic radius extends into a more diversified industrial area; a considerable part of the mineral-working Upper Palatinate is controlled by Nuremberg firms, while Fuerth concentrates and works all the glass from the Bavarian Forest, the Fichtelgebirge, the Spessart, and even from Saxony. Toys and pencils are only two of the outstanding products of Nuremberg which have won world reputation; of no less importance is the manufacture of metal ware, machinery, electric supply, notions, tools, brushes, leather and rubber ware, the spinning of metal thread, and the making of sheet-gold. That beer is another specialty is only logical for a city which houses the controlling hop-exchange of Bavaria.

Wuerzburg, the University city on the Main, holds a position of minor importance in the economic life of the country. Its local industry is closely adapted to environment, to wine, and to forest; a well-developed graphic industry, the manufacture of printing presses, and of mathematical instruments reflect the academical atmosphere. Handicapped by location—it lies in a regular basin surrounded by vineyard hills—its industrial development was hindered, and the energy of its citizens turned time and again towards neighboring cities, such

as Aschaffenburg, Kitzingen, or Schweinfurth, cities which are about to overshadow more and more the industrial importance of Wuerzburg.

Among the urban concentrations of Rhenish Palatinate, Ludwigshafen on the Rhine is by far the most prominent city; due to the "Badische Anilin," as Germany's largest chemical plant is called, the city holds the record in recent growth of population (22.3 per cent since 1910) among the larger Bavarian cities. An example of intensive industrial specialization is furnished by the city of Pirmasens, where 811 out of every 1,000 industrially active persons are employed in the shoe industry, one of the specialties of all Palatinate. Kaiserslautern, the capital, possesses a considerable number of smaller industries, among which the manufacture of sewing machines is probably the best known. Other cities of the populous Palatinate became fairly prosperous by making a close adjustment to their physical environments, such as Neustadt, Landau, and Speyer to wine, tobacco, and agriculture, in general.

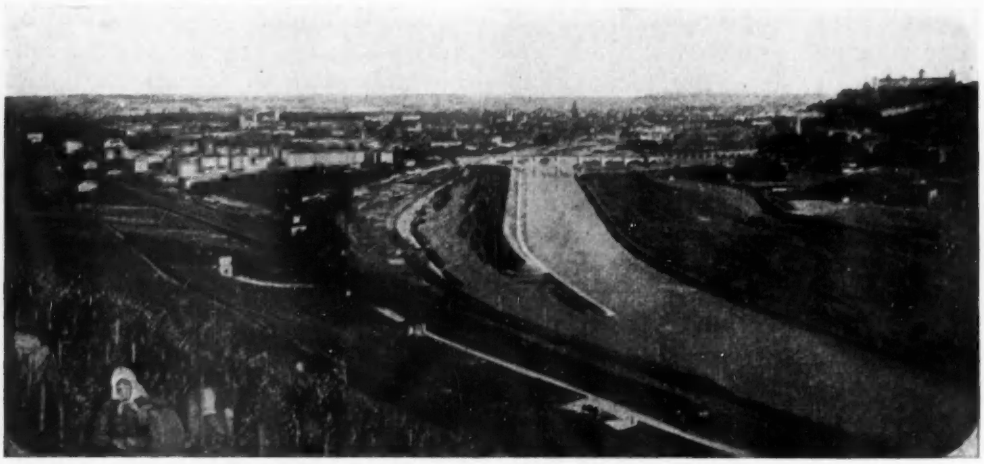


FIGURE 11.—Vineyards near Wuerzburg on the Main.

## CONCLUSION

Any economic analysis by locating factors is necessarily lacking the thoroughness which a more statistical survey would require. The analytical treatment of Bavaria's economic life, as has been attempted here, does, therefore, not claim completeness; it rather intended to bring out some of the typical and original adjustments which are underlying the present economic face of the country, and which since partly obliterated by modern development, do so easily escape the attention of an observer who is not familiar with the particular traits of Bavarian life.

In summarizing it may be said, that Bavaria's economic adjustments to the large number of its environmental elements are as complex in nature as they are intensive in effect. That these adjustments have not succeeded and probably never will succeed in raising the economic standard of the country to the ideal of a harmonious economic unit is a fact which should not be forgotten over the estimable degree of economic

balance already achieved. The country contributes a considerable share to Germany's economic needs from a few surplus products, and some of its specialties even reach into far-away markets; but in order to feed its 7 million people it is dependent upon import from various parts of Germany and from neighboring countries, and many a raw material from oversea is necessary to keep the wheels of its industries going.

If not all of its economic adjustments came up to the standard of modern efficiency, the reason may largely be found in the handicap of a slow historical evolution, as is the case with most old-world countries. But, it may in part also be attributed to the conservative character of its people. For, while the Bavarians are undoubtedly a progressive and temperamental people, there is among them a certain reluctance to adopt the hyper-modern ways of standardization, of condensing life into a single formula, a restraint almost second nature to a people, carrying on the struggle for existence in such manifold forms as the Bavarians do.

The keynote of Bavaria's economic life, which like other German regions suffers under the effects of the World War, is, therefore, and must continue to be, "quality rather than quantity," a keynote likely to strengthen the peculiar framework on which the economic welfare of the country is resting.

# AGRICULTURAL REGIONS OF NORTH AMERICA

## PART VIII—THE PACIFIC SUBTROPICAL CROPS REGION (*Continued*)

*Oliver E. Baker*

Senior Agricultural Economist, U. S. Department of Agriculture

### FRUITS AND NUTS

THE Pacific Subtropical Crops Region is unique in the production of fruit (Fig. 224). Although the acreage of all fruits in the region is only about one-fourth that of all crops, the value is fully half that of all crops. The great importance of fruit in the region is owing largely to the Mediterranean type of climate. Over 90 per cent of the dried fruit produced in the United States is produced in California. The principal fruits are grapes (about 650,000 acres in 1929), plums and prunes (230,000 acres), oranges (about 215,000 acres), peaches (155,000 acres), apricots (93,000 acres), pears (95,000 acres), apples (63,000 acres), figs (60,000 acres), lemons (46,000 acres), olives (32,000 acres), cherries (19,000 acres), grapefruit (7,000 acres), and avocados (5,000 acres). The following fruits are also grown commercially in the region: Japanese persimmons (3,000 acres), pomegranates (2,000 acres), loquats, guavas, tangerines, and citrons.[12]

Grapes are the principal fruit based on acreage, but citrus fruit has now a much greater value. The farm value of the grape crop in recent years has ranged from $50,000,000 to $55,000,000, except in 1928, when it fell to only $36,000,000. Three-fourths of all the grapevines in the United States are in California, and these produce nearly nine-tenths of the crop of the nation. The great center of production is the San Joaquin Valley, where there are nearly 500,000 acres of vines (Fig. 225). Some of these grapes are shipped to the East for table use, more are made into wine, and much more are dried into raisins, principally on the farm where grown. Most of the raisins of the United States, and over half of the raisins of the world, are produced in this valley (Figs. 226 and 227). The sunshine is almost continuous in the summer and early fall. Most of the grapevines are irrigated, but few are fertilized. Fresno is the center of this raisin area. About one-fourth of the raisins are exported, mostly to northwestern Europe and Canada.

In the Sacramento Valley there are about 45,000 acres of grapes, over one-third of which are in the Sacramento County. In this valley table and juice (wine) grapes mostly are grown. These grapes are largely grown without irrigation, but the use of water is increasing. In the valleys to the north and south of San Francisco Bay there are 55,000 acres in vines, mostly juice grapes. Only a small acreage is irrigated. The wines from these valleys formerly were famous, and some wine is still produced for medical and sacramental purposes. In the Valley of Southern California there are about 64,000 acres of grapes, mostly on the very

[12] California Crop Report, 1928, by E. E. Kaufman and others, Calif. State Dept. of Agr. and U. S. Dept. of Agr. coöperating, Sacramento, 1929.

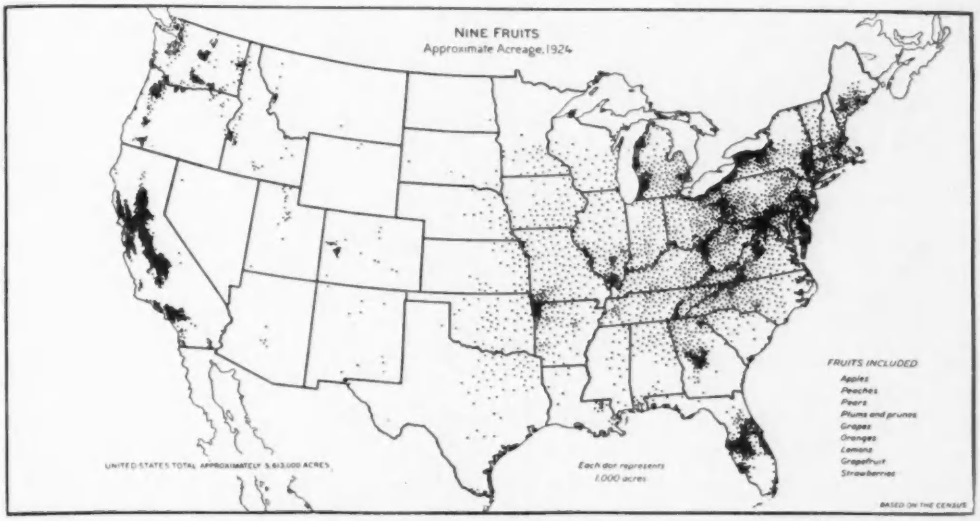



FIGURE 224.—California contributed over one-sixth of the nation's acreage of fruits and nuts in 1919 and over one-third of the value. The proportions are probably greater today. The district in Southern California consists mostly of citrus fruits, walnuts, and apricots, with some peaches and grapes; the San Joaquin Valley district is largely devoted to grapes, peaches, and apricots, with some citrus fruit and figs; the Sacramento Valley district is more mixed, including grapes, peaches, prunes and plums, apricots, pears, almonds, and some citrus and walnuts; while the valleys to the north and south of San Francisco Bay specialize in prunes, grapes, apricots, and pears, with some almonds and walnuts and with apples in the Sonoma and Pajaro valleys, where the air is cooled by breezes from the ocean. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

sandy soils between Rialto and Ontario. These are largely unirrigated. Many of the largest orchards in this valley and elsewhere are operated by natives of Italy or their descendants. Contrary to expectations, national prohibition of alcoholic beverages proved a great boon to the grape industry of California. The number of vines increased 60 per cent between 1919 and 1924, whereas between 1909 and 1919 the number had decreased. Between 1924 and 1928 the bearing acreage further increased 25 per cent, and there is serious overproduction.

Citrus fruits now greatly exceed grapes in value, owing partly to the low prices of grapes, but occupy less than half as large an acreage. Oranges constituted about 80 per cent of the total citrus acreage in 1924; lemons, 18 per cent; and grapefruit, 2 per cent. The citrus center is in Southern California, principally on the alluvial fans and piedmont slopes that partly surround the valley which extends from Los Angeles east to Redlands, and on the large alluvial fan in Orange County built up by the Santa Ana and Santiago rivers (Fig. 228). Water for irrigation is obtained from the streams higher up in the mountain canyons and from wells sunk in the alluvial fans or "washes." The elevation of these fans also provides excellent drainage, both of water and of air. Three-fourths of the bearing orange trees in the region (about 145,000 acres) and nearly all of the trees not of bearing age (23,000 acres) are in Southern California (Figs. 229–230). Most of the remainder are in the San Joaquin Valley, largely in the Porterville and Lindsay districts in Tulare County. There are also a number of orange orchards on the piedmont margins

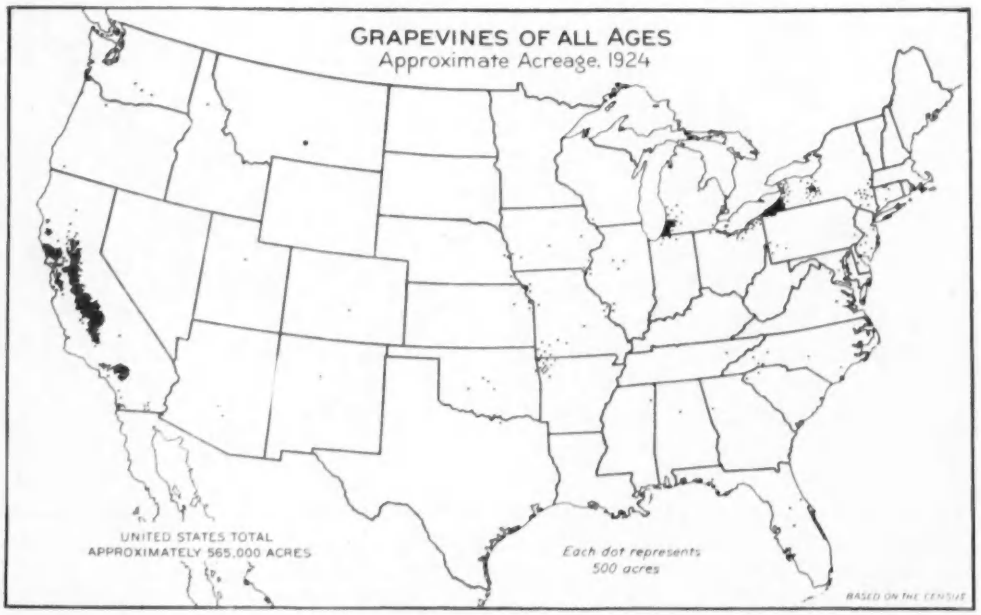



FIGURE 225.—Three-fourths of the nation's acreage of grapes is in California. The major district, devoted largely to raisins, centers around Fresno, in the San Joaquin Valley, where the land is nearly level and the sunshine almost continuous. The production of table grapes is also important in the San Joaquin Valley, but extends northward into the Sacramento Valley. Wine or juice grapes are grown in many parts of the state, but the bulk of production is in the Sacramento Valley and the valleys to the north and south of San Francisco Bay. A smaller center of grape production may be noted in Southern California, the largest vineyards lying a few miles west of San Bernardino. The area in grapes in California is now about 650,000 acres, and the average production about 2,300,000 tons (excluding 150,000 tons left unpicked). (Map from 1921 Yearbook, U. S. Dept. of Agr.)

of the Sacramento Valley in Sacramento, Butte, and Glenn Counties. The value of the orange crop of California in recent years has ranged from $60,000,000 to $90,000,000.

Lemons, likewise, are grown mostly in Southern California, and, unlike oranges, there is as large acreage outside the Los Angeles-Redlands Valley as in it. There are about 12,000 acres in Los Angeles County, 8,000 in northern Orange County and nearly as many in Ventura County, largely in the Santa Paula district, over 5,000 acres in San Bernardino County and nearly 5,000 in San Diego County, 4,000 acres in Riverside County and 2,000 acres in Santa Barbara County. There are also about 3,000 acres of trees in the San Joaquin Valley, and 850 acres in the Sacramento Valley. The value of the lemon crop of the State averages $20,000,000.

Grapefruit is grown in the Los Angeles-Redlands Valley, but the acreage in the Imperial Valley in the desert on the east side of the mountains, mostly young trees, is now slightly greater. Production of grapefruit is, as yet, not very important in the Pacific Subtropical Crops Region, amounting to nearly 1,000,000 boxes. There are about seven times as many lemon trees as grapefruit in the region, and nearly thirty times as many orange trees. Grapefruit, as well as oranges and lemons, are practically always irrigated and heavily fertilized. Cover crops are often grown in the winter and plowed under in the spring. The marketing

FIGURE 226.—This picture, taken in the San Joaquin Valley, shows the trays of grapes drying into raisins in the sun, and the vines from which the grapes were picked growing on either side. It will be noted that the vines are not supported by wires and grow only 3 to 5 feet high, the support being the trunk of the vine. The average yield per acre of grapes in this district is 4 tons, which dry into about one ton of raisins. (Photo from California Development Assn., San Francisco.)

of the citrus fruit of the region is doubtless the best organized of any agricultural commodity in the nation (Figs. 231, 232, and 233).

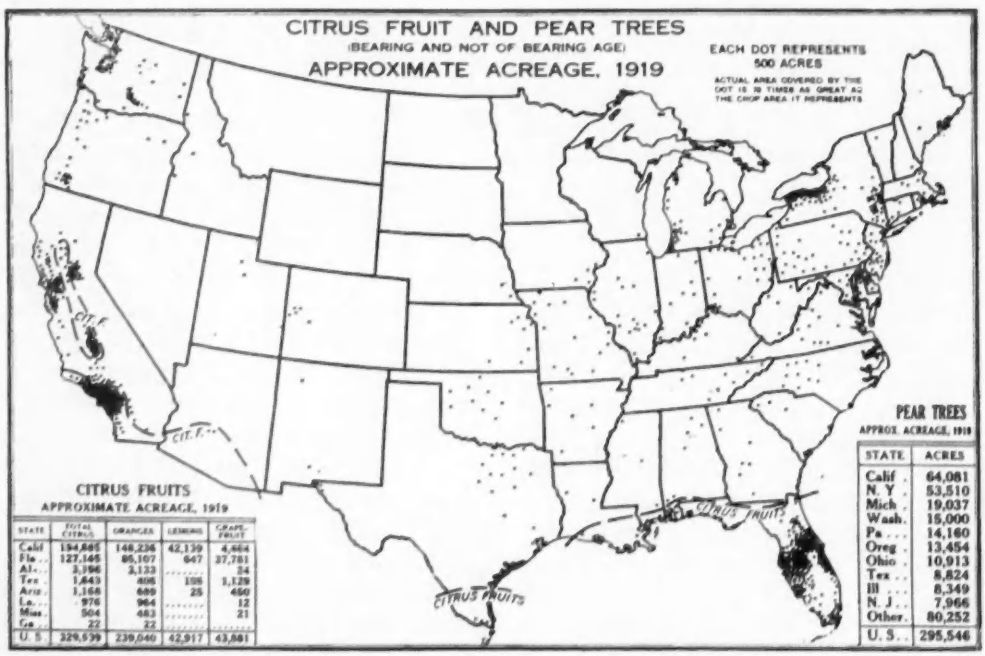
There is almost no citrus fruit grown commercially in the coastal valleys that drain into San Francisco Bay, nor in the Salinas Valley or along the coast north of Point Conception. The climate is a little too cool.

Prunes and plums, on the other hand, are produced principally in the San Francisco Bay valleys—nearly 80,000 acres in the Santa Clara Valley, nearly 30,000 acres in the Sonoma Valley, and 12,000 acres in the Napa Valley. These are mostly prunes. A large area, 60,000 acres, is also found in the Sacramento Valley, and nearly 30,000 acres in the San Joaquin Valley. The Pacific Subtropical Crops Region produces over half, in some years three-fourths, of the prunes of the world. Usually about half of the prunes are exported, mostly to northwestern Europe. The farm value of the crop ranges from $15,000,000 to $25,000,000 a year, to which should be added $2,000,000 for plums. A third of the fresh plum crop of the United States is produced in California.

Peaches are grown principally in the Great Valley (Figs. 234 and 235). There were, in 1924, about 60,000 acres of trees on the east side of the San Joaquin Valley, centering around Fresno and Merced, and nearly 50,000 acres in the Sacramento Valley centering in Sutter County. Nearly all the peaches are irrigated in the San Joaquin Valley, except where the water table is near the surface, but only a part of the orchards in the Sacramento Valley. Most of the peaches are canned or dried. In addition, Southern California had 23,000 acres of trees, mostly in the Ontario-Cucamonga section, and in the Hemet and San Fernando valleys. Table peaches are produced in the Beaumont-Yucaipa district. The value of the peach crop of California ranges from $10,000,000 to $20,000,000 annually. California produces about 98 per cent of the canned peach pack of the United States and practically all of the dried peaches. The dried peaches of California constitute over 90 per cent of the dried peach production of the world.

FIGURE 227.—Trays of raisin grapes drying in the sun. As the industry has grown, the assembling of the trays in one area has been found desirable. The sheds in the background are used for bleaching the raisins by means of sulphur dioxide fumes. However, only a small proportion of the raisin crop is bleached. (Photo from U. S. Bur. of Agr. Economics.)

Apricots are also an important crop in the region. The three principal centers of production are the Santa Clara Valley at the south end of San Francisco Bay, the San Joaquin Valley, and the valleys of




| STATE | TOTAL CITRUS | ORANGES | LEMONS | GRAPE-FRUIT |
|---|---|---|---|---|
| Calif | 194,865 | 148,236 | 42,139 | 4,464 |
| Fla | 127,145 | 85,107 | 647 | 37,781 |
| Ari. | 3,196 | 3,133 | ..... | 34 |
| Tex | 1,643 | 406 | 108 | 1,129 |
| Ariz | 1,168 | 649 | 25 | 460 |
| La. | 976 | 964 | ..... | 12 |
| Miss. | 504 | 483 | ..... | 21 |
| Ga | 22 | 22 | ..... | ..... |
| U. S | 329,539 | 239,040 | 42,917 | 43,881 |

| STATE | ACRES |
|---|---|
| Calif. | 64,081 |
| N. Y. | 53,510 |
| Mich. | 19,037 |
| Wash. | 15,000 |
| Pa. | 14,160 |
| Oreg. | 13,454 |
| Ohio | 10,913 |
| Tex. | 8,824 |
| Ill. | 8,349 |
| N. J. | 7,966 |
| Other. | 80,252 |
| U. S. | 295,546 |

FIGURE 228.—Over half of the nation's acreage of citrus fruit is in California, nearly 45 per cent in Florida, and 5 per cent in Texas and the Gulf States and in Arizona. In California about 80 per cent of the acreage is in Southern California and nearly 20 per cent in the Great Valley. The citrus fruit is grown mostly on the alluvial fans and piedmont slopes, where there is less danger from frost. Practically all the acreage is irrigated. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

Southern California. Unlike prunes and peaches, a considerable proportion of the crop is sold fresh for consumption in the state. However, over two-thirds of the apricots are dried and one-fourth are canned. The crop averages about $10,000,000 in value. California produces over 99 per cent of the apricot crop of the nation.

Pears, apparently, prefer a little cooler climate than peaches and apricots, especially in winter. The acreage in the valleys to the north of San Francisco is larger than in the Santa Clara Valley to the south, and a large acreage is also found on the foothills and valley slopes of the Sacramento Valley, notably in Sacramento, Solano, and Placer Counties. There are over 5,000 acres in Los Angeles County, principally in the Antelope and San Fernando valleys. The total area in the region is 95,000 acres. More than half the pears (about 57 per cent) are shipped fresh to Eastern markets, about 30 per cent are canned, and about 12 per cent are dried. The farm value of the crop varies from $7,000,000 to $10,000,000.

Apples are grown in the cooler parts of the region, principally in the Watsonville district on the eastern shore of Monterey Bay and adjoining Pajaro Valley, and in the Sebastopol district on the west side of the Sonoma Valley, which is one of the leading early apple districts in the United States. Both these districts are exposed to the fogs and cool winds from the ocean. Apples are also grown in the Yucaipa Basin in the San Bernardino Mountains and around Beaumont and Banning, at an elevation of 2,200 to 2,600 feet. Here the temperatures are lower than

FIGURE 229.—This picture, taken in Southern California, shows young orange trees in the foreground, apricot trees in bloom beyond on the slightly lower land, eucalyptus trees in the valley bottom in the middle distance, doubtless with grain crops and pasture in the fields between the tree rows, while on the opposite slopes of the valley fruit orchards may be seen indistinctly. Rising behind are the San Bernardino Mountains, partly snow-covered, from which comes most of the water for the orchards in the valley. (Photo by G. Harold Powell, formerly of Bur. of Plant Industry.)

FIGURE 230.—A nearer view of an orange grove, with a fairly characteristic house, garage, and water tank. Notice the tillage between the trees and the furrows evidently prepared for irrigation, also the wide spacing between the trees to allow ample room for the roots and for the sun to color the fruit. Such wide spacing is convenient, moreover, when driving a team of horses between the rows in cultivating and harvesting. (Photo from Los Angeles Chamber of Commerce.)

in the nearby valleys, but much higher than in the coastal districts. The apples in the coastal districts are mostly unirrigated, but those in the Southern California mountains are irrigated. The value of the apple crop of California ranges from $5,000,000 to $10,000,000.

Cherries (nearly all sweet) are much less important, only about 1,500,000 trees in the region. The crop, which is mostly canned, has brought in recent years from $2,000,000 to $4,000,000. Cherries are grown principally in the San Francisco Bay valleys, and in the cooler, central portion of the Great Valley, near its opening into San Francisco Bay. There are also a number of orchards in the Southern California valleys. Olives are an important fruit in certain sections of Southern California, notably in Los Angeles, Riverside, and San Diego Counties, in the central San Joaquin Valley, and in Butte, Sacramento, and Placer

FIGURE 231.—Typical citrus packing house in Southern California. Notice the roof arrangement to admit abundant light and the artistic office entrance. (Photo from U. S. Bur. of Agr. Economics.)

Counties, in the Sacramento Valley. There are about 1,500,000 trees in the region and the average crop is worth $1,000,000. Olives are very resistant

to drought and most of the orchards are unirrigated. Unlike Mediterranean olives the California crop is mostly picked ripe, as there is no fly to make wormy fruit.

Figs likewise are an important fruit locally in the central San Joaquin Valley, with a few trees in the Sacramento Valley, and in Los Angeles and San Diego Counties in Southern California. There were in all about 1,000,000 trees in the region in 1920, and the crop in recent years has sold for from $500,000 to $1,500,000. California produces about one-third of the dried figs consumed in the United States, two-thirds being imported. Recently about 10 per cent of the crop has been canned fresh and 6 per cent eaten in the fresh state.

The only other fruits of much commercial importance are avocados, whose production is almost confined to Southern California; Japanese persimmons, which are also grown mostly in Southern California and in Tulare and Placer Counties in the Great Valley; and pomegranates, grown mostly in Tulare County. Guavas, loquots, and tangerines are grown commercially by a few farmers, and it is quite common for city dwellers, as well as farmers, to have a tree or two of each growing in the yard to produce fruit for home use.[13]

FIGURE 232.—Washing oranges in a packing house. Notice the revolving rollers to rub off all dirt or adhering spray, and the endless belt conveyors. (Photo from U. S. Bur. of Agr. Economics.)

The list of California products would not be complete without mentioning nuts. Walnuts ("English" or "Persian") are a very important crop in Southern California, particularly in Los Angeles, Orange, and Ventura Counties (Fig. 236). However, a few orchards produce fruit for sale in nearly every county in the region. There were about two million trees in the state in 1920 (Fig. 237), and the area of bearing trees is estimated in 1929 as 87,000 acres, with 40,000 acres more not of bearing age. The value of the crop in recent years has ranged from $7,000,000 to $17,000,000. Almonds are the other important nut. These are grown mostly in San Luis Obispo County in the Central Coast sub-region, in the Sacramento Valley, and in the northern, cooler portion of the San Joaquin Valley. There are, however, a number of orchards in Southern California and in the "Bay Counties." The number of trees in the region totaled nearly four millions in 1920, and the present value of the crop is about $10,000,000. The estimated area in 1929 was 92,000 acres of bearing trees and 6,000 acres of non-bearing trees.

### VEGETABLES

California is also the greatest vegetable-producing state in the nation, and, except for the Imperial Valley, nearly all the commercial crop is produced in the Subtropical Crops

[13] Dates are a crop of rapidly increasing importance in the Coachilla Valley of Southeastern California, but no dates are produced commercially in the Subtropical Crops Region.

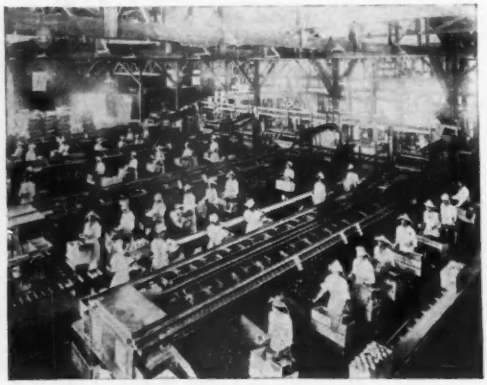
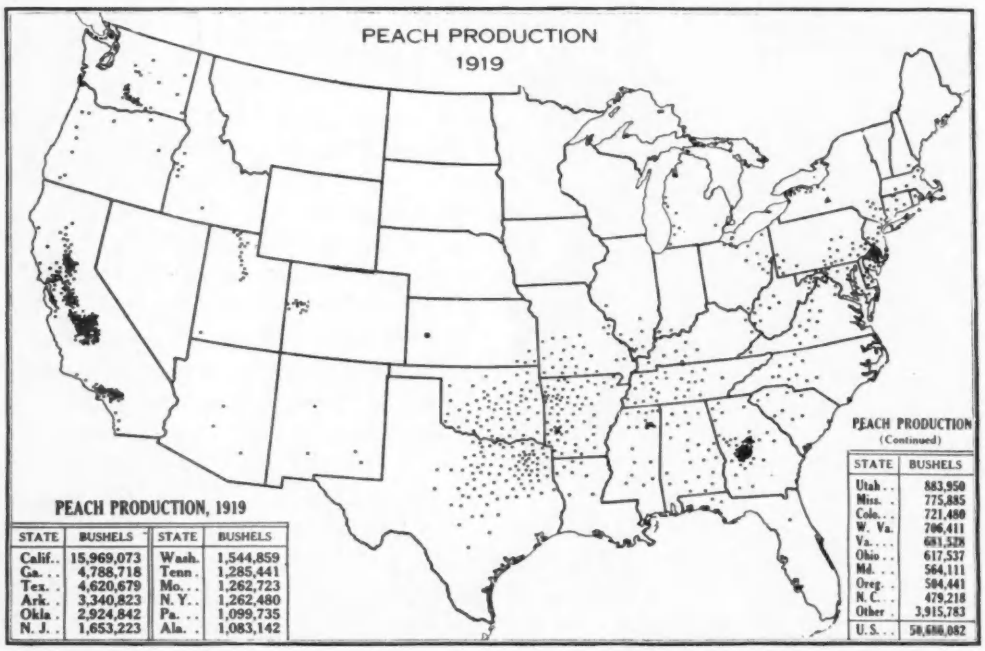


FIGURE 233.—Inside the packing house. Notice the machines which sort the oranges in standard sizes, and the wrapping in tissue paper and packing, which is done by hand; note also the belt conveyors carrying the packed boxes away. Box material can be seen on the left, and a machine for assembling and nailing boxes on the right beyond the sorting machines. (Photo from U. S. Bur. of Agr. Economics.)

Region (Fig. 238). Potatoes have been the leading vegetable in area until recently, occupying about 50,000 acres. The cool "Delta" district, where the Sacramento and San Joaquin Rivers have built up a marshy area with muck soils, is one of the important potato-producing districts of North America. There are also several thousand acres in Southern California, mostly near Los Angeles. These are principally early potatoes. The average value of the crop in the state is about $10,000,000. Tomatoes rank second in acreage, occupying usually from 40,000 to 50,000 acres. The centers of production are in Southern California, especially around Los Angeles, in the cooler central section of the Great Valley, in the Santa Clara Valley, and in Alameda County. The tomatoes are both canned and shipped fresh, especially in the late fall. The crop normally is worth about $5,000,000.

Lettuce recently has become a very




| STATE | BUSHELS | STATE | BUSHELS |
|---|---|---|---|
| Calif. | 15,969,073 | Wash. | 1,544,859 |
| Ga. | 4,788,718 | Tenn. | 1,285,441 |
| Tex. | 4,620,679 | Mo. | 1,262,723 |
| Ark. | 3,340,823 | N. Y. | 1,262,480 |
| Okla. | 2,924,842 | Pa. | 1,099,735 |
| N. J. | 1,653,223 | Ala. | 1,083,142 |

| STATE | BUSHELS |
|---|---|
| Utah | 883,950 |
| Miss. | 775,885 |
| Colo. | 721,480 |
| W. Va. | 706,411 |
| Va. | 681,528 |
| Ohio | 617,537 |
| Md. | 564,111 |
| Oreg. | 504,441 |
| N. C. | 479,218 |
| Other | 3,915,783 |
| U. S. | 50,680,082 |

FIGURE 234.—California produces from one-fourth to one-half of the nation's peach crop, varying with the season, Fresno County alone producing normally one-tenth. About half of the peaches of California are grown in the San Joaquin Valley. Other important districts are located in the Sacramento Valley and in Southern California, but it will be noted that there are relatively few peaches in the valleys north and south of San Francisco Bay. Most of the peaches of California are canned, but a few are shipped fresh to the Eastern States. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

FIGURE 235.—Picking peaches in the San Joaquin Valley. Note that the peaches are picked into pails, then dumped into boxes, which are loaded on trucks and hauled to the canning factory. Also notice the bright sunshine and the sharp shadows characteristic of a dry climate. (Photo supplied by California Packing Corporation, through the California Development Assn.)

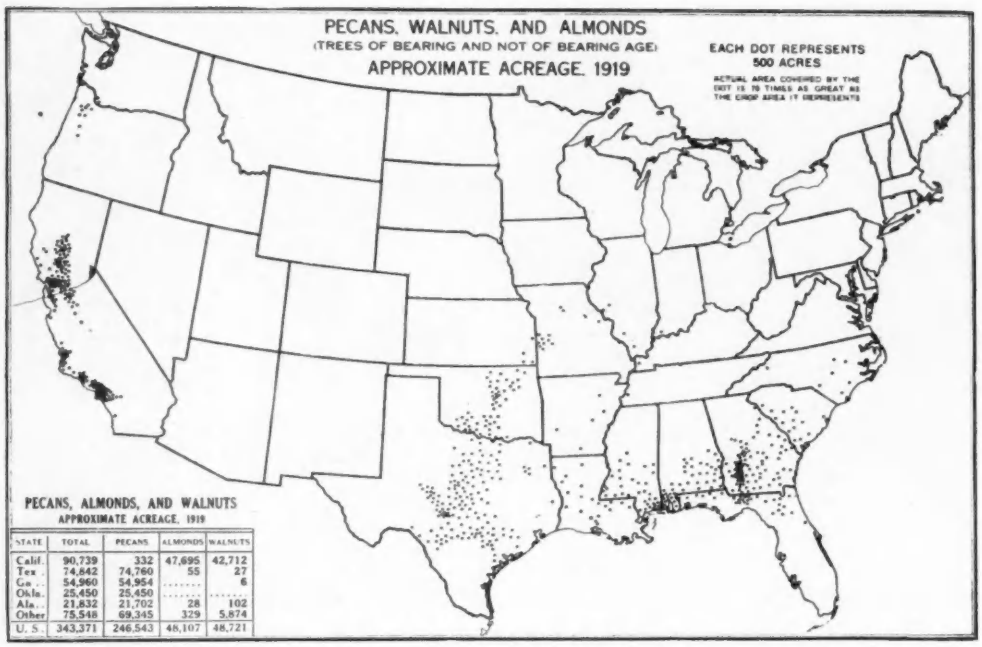
important crop. The area in lettuce, excluding the Imperial Valley, ranges now from 40,000 to 60,000 acres, and the value of the crop in the region in 1928 and 1929 exceeded that of potatoes, being about $14,000,000. Nearly two-thirds of the nation's commercial crop is now grown in California, and lettuce even in the Eastern States has become almost as common and as cheap in winter as in the summer. Car-lot shipments both from California and from other states have increased four-fold during the past decade. This is owing largely to the development of a superior variety, the Iceberg. California also produces over two-thirds of the nation's asparagus, grown mostly in the Delta district. The acreage of asparagus in California now exceeds that of potatoes. This is true also of

TABLE I

CALIFORNIA COMMERCIAL VEGETABLE CROPS

TREND OF CAR-LOT SHIPMENTS IN RECENT YEARS AND FARM VALUE OF CROP IN 1928

| *Crop* | *Car-Lot Shipments—Number of Cars* | | | | | *Estimated Value of Crop* |
|---|---|---|---|---|---|---|
| | 1920 | 1922 | 1924 | 1926 | 1928 | 1928 |
| Asparagus | 502 | 304 | 718 | 1,503 | 1,876 | $8,800,000 |
| Cabbage | 913 | 647 | 376 | 412 | 702 | 1,100,000 |
| Cantaloupes | 13,251 | 15,304 | 19,932 | 18,320 | 25,271 | 12,300,000 |
| Carrots | 111 | 21 | 157 | 557 | 2,929 | 1,900,000 |
| Cauliflower | 2,957 | 3,604 | 3,404 | 4,730 | 7,525 | 3,000,000 |
| Celery | 3,472 | 4,334 | 4,240 | 7,565 | 9,560 | 2,700,000 |
| Lettuce | 7,358 | 9,744 | 18,480 | 27,341 | 33,446 | 20,100,000 |
| Onions | 4,802 | 4,349 | 2,671 | 3,013 | 4,489 | 2,200,000 |
| Peas (green) | ..... | ..... | ..... | 803 | 1,636 | 5,000,000 |
| Potatoes | 10,953 | 7,766 | 9,714 | 8,614 | 7,562 | 5,100,000 |
| Spinach | 326 | 302 | 70 | 305 | 334 | 1,400,000 |
| Sweet Potatoes | 856 | 982 | 466 | 1,186 | 767 | 1,300,000 |
| Tomatoes | 2,004 | 2,349 | 2,789 | 4,443 | 4,423 | 5,400,000 |
| Watermelons | 3,390 | 4,302 | 4,305 | 6,278 | 5,593 | 1,100,000 |




| STATE | TOTAL | PECANS | ALMONDS | WALNUTS |
|---|---|---|---|---|
| Calif. | 90,739 | 332 | 47,695 | 42,712 |
| Tex. | 74,642 | 74,760 | 55 | 27 |
| Ga. | 54,960 | 54,954 | ..... | 6 |
| Okla. | 25,450 | 25,450 | ..... | ..... |
| Ala. | 21,832 | 21,702 | 28 | 102 |
| Other | 75,548 | 69,345 | 329 | 5,874 |
| U. S. | 343,371 | 246,543 | 48,107 | 48,721 |

FIGURE 236.—Only three kinds of nuts are produced in the United States on a commercial scale—pecans, walnuts, and almonds. The pecans are practically confined to the Southern States, the walnuts and almonds to California, except for a small acreage of walnuts in western Oregon and Washington. The area shown in Southern California is mostly walnuts, while in the Great Valley both nuts are grown, and in the Santa Clara Valley mostly almonds. Only about half the walnut acreage and a quarter of the almond acreage in California is irrigated, according to the Census. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

cantaloupes in 1929. Two-thirds of the nation's car-lot shipments of cantaloupes originate in California, but three-fourths of the 40,000 to 50,000 acres in California are in the Imperial Valley, which lies outside the Pacific Subtropical Crops Region (Figs. 239 and 240). Green peas have recently become an important crop, occupying 19,000 acres in 1929, with 13,000 acres more in the Imperial Valley. Nearly all kinds of vegetables grown anywhere in the United States are grown extensively in California. Table I shows the trend of car-lot shipments of vegetables in alternate years since 1920 and also the value in 1928.

### GARDEN SEEDS AND FLOWERS

In addition to providing the markets of the nation with a large proportion of the winter vegetable supply, California provides most of the vegetable and flower seeds for the nation. In the Santa Clara Valley there are hundreds of acres devoted to this industry and the business has now spread to other parts of the state. Many carloads of flowering plants and flowers are also shipped east during the winter season. Fields of these seed and flower crops in bloom are a pretty sight—one of the most beautiful in a beautiful state.

### PASTURES

Although there are probably over 30,000,000 acres of pasture land in the Pacific Subtropical Crops Region, only 12,000,000 acres were reported in farms by the census in 1924. Of this acreage about 2,500,000 was pasture land that "could be plowed and used for crops without clearing,

FIGURE 237.—The Persian or French walnut is a beautiful tree, with a smooth light-colored bark and far-spread branches, well covered with leaves. This picture, taken in Southern California, shows a road through a walnut orchard. The walnuts on the trees are too small to be seen. The average production is from one-third to one-half ton per acre, and there are about 90,000 acres of bearing trees and 40,000 acres of non-bearing trees in California. (Photo from Los Angeles Chamber of Commerce.)

draining, or irrigating," another 2,500,000 acres were woodland pasture, and 7,000,000 acres were reported as "other" pasture, which means natural grassland not suitable for crop production.

Two-thirds of the plowable pasture is located in the Great Valley and consists almost wholly of valley lands capable of growing grain; in fact, most of it doubtless has grown grain in years past. A little of it (perhaps 200,000 acres) is alfalfa pasture. About one-fifth of the plowable pasture is in the hills and valleys west of the Great Valley and north of Point Conception, and still less is in Southern California. Over half of the woodland pasture is also found in the Great Valley, and consists of both the open live-oak groves and the "chaparral" belt that fringes the valley on both sides.[14] In addition to the 2,500,000 acres in farms, there are about 3,000,000 acres not in farms in the Region.

The native grassland pasture too dry or too rough for crops is much more extensive. Half of the area reported in farms was in the Great Valley; a third in the Coast ranges and valleys; and less than a sixth in Southern California. This natural grassland is of diverse character. Apparently before the coming of the stockmen, the principal species were California Poa (blue grass) and a stepa (needle grass), with scattered lupines and clovers. These early gave way, owing to overgrazing, to wild oats and bur clover, and these in turn to filaree, then fox-tail grass, and, finally, to red brome grass. At present this grassland is characterized by weedy annual plants, which "following the winter rains produce a luxuriant carpet, dotted by many showy flowering plants, such as California poppy. The vegetation matures early and remains during a long summer rest period in a dried condition."[15] Most of this natural grassland is used as yearlong range, and the carrying capacity ranges from 25 to 75 acres per cow or mature steer. Along the eastern side of the Great Valley some of this grazing land will carry a cow on as few as fifteen acres.

## LIVESTOCK

Prior to American annexation at the close of the Mexican War, much of the land in the Pacific Subtropical Crops Region was owned by Mexi-

[14] Chaparral is a growth of shrubs and small trees and consists largely of Highland live-oak (*Quercus wislizeni*), scrub-oak (*Quercus Jumosa*), hollyleaf cherry (*Prunus ilicifolia*), sumac (*Rhus laurina*), wild lilac (*Ceanothus hirsutus*), and manzanita (*Arctostaphylos glauca*). Growing between the shrubs are several grasses and numerous flowering plants.

[15] Shantz and Zon: "Atlas of American Agriculture," Section Natural Vegetation, U. S. Dept. of Agr., 1924. Sequence of vegetation resulting from overgrazing, worked out by E. O. Wooten, Bureau of Agricultural Economics.

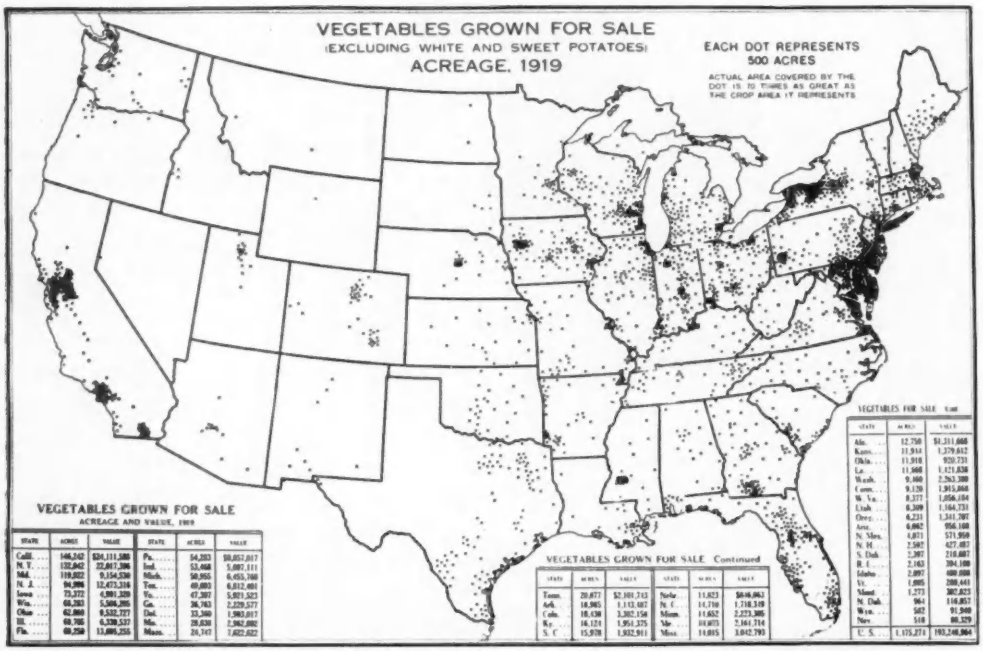
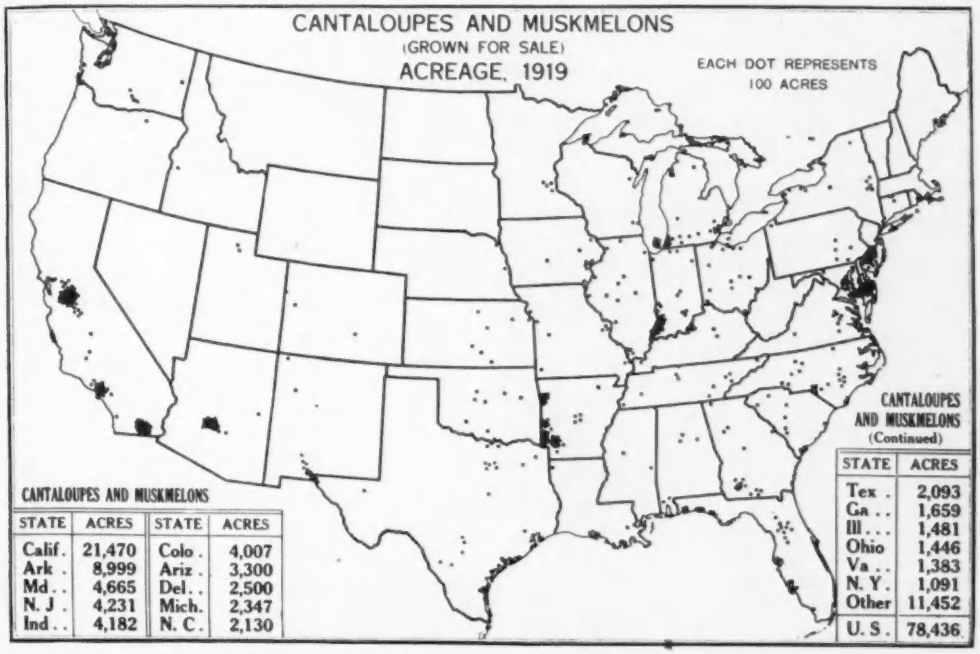



FIGURE 238.—California grows more vegetables than any other state. It possesses four major areas of production, three of which are in the Pacific Subtropical Crops Region. The largest district is in the central portion of the Great Valley, and includes the potato, celery, cabbage, and asparagus district of the marshy Sacramento-San Joaquin Delta, and the cantaloupe and watermelon district around Turlock. Tomatoes are an important crop in many places in the Great Valley. The vegetables grown in this valley are largely shipped East. Next in importance is the Los Angeles district where nearly all kinds of vegetables are grown, including sweet corn, principally for the Los Angeles market. Less important is the San Francisco Bay district which is mostly devoted to green peas, sweet corn, tomatoes, and other vegetables for the adjacent cities. There is also a considerable acreage of lettuce in the Salinas Valley. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

cans in large units, granted originally by the Spanish Crown, and used almost wholly for the production of beef cattle. Even now most of the land in the Coast ranges and valleys south of the Santa Clara Valley as far as the valleys of Southern California, also in the western portion of the San Joaquin Valley, is used for grazing cattle. But, with the intensive utilization of the best land for fruit, vegetables, and alfalfa, and with the development of an urban civilization, the dairy cow has been gradually replacing the beef animal, until now the farm value of milk and dairy products in the region amounts to fully $80,000,000 annually.[16] This is probably as much as in Ohio, Illinois, or Iowa, and is as great as the combined value of the grape and the prune crops. The value of the beef and veal produced, on the other hand, including that from dairy herds, probably does not exceed $40,000,000.

Over half the dairy cows in the Region are in the Great Valley (242,000 in 1924), principally in the San Joaquin section; one-fourth are in the San Francisco Bay district and valleys to the south as far as Point

[16] The census for 1924 gives $50,000,000, but this was a very dry year. The "Statistical Report of California Dairy Products," issued by the State Department of Agriculture, gives the value of dairy products of California in 1927 and also in 1928 at over $150,000,000; but as this includes market milk at close to retail price, it appears better to use the estimates of value of milk fat sold by farmers. This was $89,000,000 in 1928. It is possible that the farm value of the milk produced may now (1929) be close to $100,000,000.




| STATE | ACRES | STATE | ACRES |
|---|---|---|---|
| Calif. | 21,470 | Colo. | 4,007 |
| Ark. | 8,999 | Ariz. | 3,300 |
| Md. | 4,665 | Del. | 2,500 |
| N. J. | 4,231 | Mich. | 2,347 |
| Ind. | 4,182 | N. C. | 2,130 |

| STATE | ACRES |
|---|---|
| Tex. | 2,093 |
| Ga. | 1,659 |
| Ill. | 1,481 |
| Ohio | 1,446 |
| Va. | 1,383 |
| N. Y. | 1,091 |
| Other | 11,452 |
| U. S. | 78,436 |

FIGURE 239.—In California about 40 per cent of the nation's commercial cantaloupe and muskmelon acreage is found, and nearly a half of the production. There are three great centers of cantaloupe production in the state: the lower San Joaquin Valley, the Los Angeles district, and the Imperial Valley. Only the first two districts are in the Pacific Subtropical Crops Region. The Imperial Valley melons are mostly shipped East in the late spring and early summer, while the San Joaquin Valley and Los Angeles district melons are shipped chiefly in July and August, long before the Eastern melons are ripe. The car-lot shipments in 1928 totaled over 25,000 cars. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

Conception (117,000); and less than one-fourth in Southern California (84,000) (Fig. 241). Production of milk per cow, however, was slightly greater in Southern California in 1924, according to the census—700 gallons as compared with 650 gallons in the Great Valley and 630 gallons in the Central Coast and Valleys. The value of dairy products per cow was still greater in the southern sub-region—$155 per cow, as compared with $104 per cow in the Great Valley and $110 in the Central Coast sub-region. This is owing to the large city population in the Los Angeles district requiring a large proportion of the milk for table use. Market milk commands a higher price than milk to be made into butter or cheese.

There are few butter factories left in Southern California, except in the city of Los Angeles and in San Diego County, whereas there is a large production of butter in the San Joaquin Valley, also in the Sonoma Valley, especially in the hills along the western edge, and in San Francisco City. Cheese also is made in the Great Valley, in the Santa Clara Valley, and along the coast as far south as Monterey County. Nevertheless, the Subtropical Crops Region produces only about three-fourths as much butter and one-third as much cheese as it consumes, receiving large shipments from the North Pacific Coast and from the Eastern States.

Beef cattle are as numerous as dairy cattle in the San Joaquin Valley

FIGURE 240.—Picking melons in Southern California. The melons are picked when still somewhat green, placed loosely in boxes and carried to the packing house. Here they are carefully sorted by condition and size and packed tightly for shipment across the continent in refrigerator cars. It may be ten days before they reach the consumer. (Photo from Los Angeles Chamber of Commerce.)

and more numerous in the Sacramento Valley, but the industry is really dominant only in the counties south from Monterey Bay to Point Conception. In this hilly and semi-arid region the beef cattle industry has made its last stand, and seems likely to persist for many years. There were about 120,000 beef cows in the Great Valley in 1924; 75,000 in the Central Coast Ranges and Valleys; and 40,000 in Southern California. The total number of cattle in the region in 1924 was 1,350,000, about 60 per cent of which were in the Great Valley.

The sheep industry was formerly important throughout the Subtropical Crops Region. In 1880 California had more sheep than any other state, but by 1900 there were only a third as many, and in 1910 there were still fewer. The census of 1920, however, showed an increase of 50 per cent over 1910, and the 1924 Census showed an increase over 1920 of 25 per cent. There were over 2,400,000 sheep in the Subtropical Crops Region in 1924 and the estimate for 1928 is 2,600,000. The higher prices for lamb and wool in recent years have encouraged the sheep industry nearly everywhere in the United States. However, the sheep are now concentrated largely in the Great Valley (Fig. 242). These valley counties reported 90 per cent of the sheep in the region in 1924, but doubtless many of these sheep graze in the mountains on both sides of the valley. The Sacramento Valley in particular has developed into one of the major lamb producing districts in the United States, and is the leading winter lamb district. About $5,000,000 worth of wool was also produced in the region in 1924.

The swine industry is only slightly developed in California, as compared with the East, partly because there is little corn grown. But it would appear that the barley crop might be used more extensively to feed hogs, as it is in northern Europe. However, the farm value of the pork and lard produced in 1927, about $15,000,000, was about as great as the value of the lamb and mutton produced. Sixty per cent of the hogs are in the Great Valley, and, unlike all other kinds of meat animals (except poultry), there are more in Southern California than in the Central Coast Ranges and Valleys sub-region. This may be owing partly to the larger quantity of the sorghums and alfalfa grown in the southern sub-region, but probably the principal reason is the garbage supplied by Los Angeles City.[17] The

[17] Prof. E. C. Voorhies, of the University of California, informs the writer that almost one-

total number of swine in the entire region on January 1, 1925, was only 325,000, which is about as many as in three average countries in Iowa, but by 1928 the number had increased to 500,000, according to the official estimates.

The poultry industry, on the other hand, is as highly developed in the Pacific Subtropical Crops Region as Ranges and Valleys sub-region, and also in Southern California, than in the Great Valley. The most concentrated center of egg production in the United States, probably in the world, is the Petaluma district in the Sonoma Valley, near San Francisco. In this small town and environs there are probably 2,000,000 hens, practically all white leghorns, while in

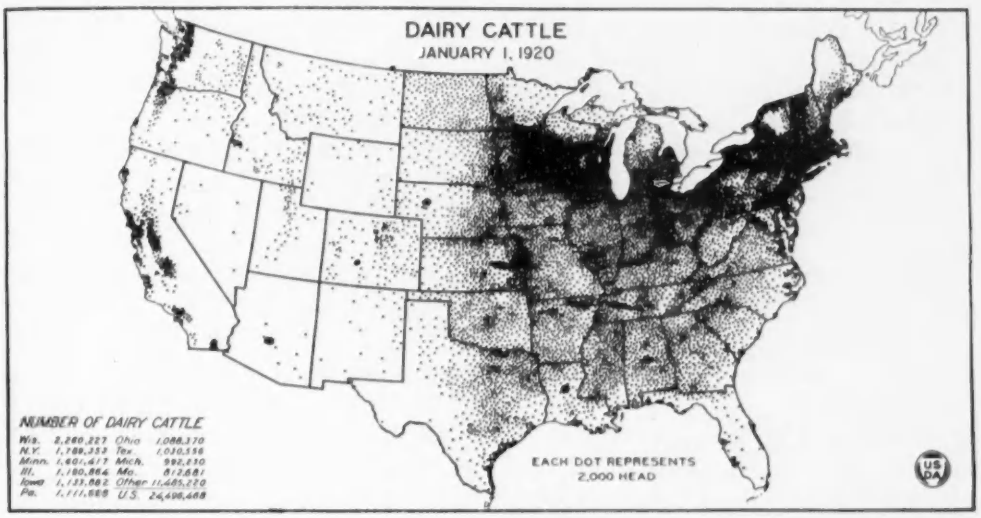



FIGURE 241.—California has become a great dairying state, though scarcely in the same class with New York, Wisconsin, and Minnesota. There were 500,000 cows milked in the Subtropical Crops Region in 1924, which, according to the Census, produced an average of 650 gallons per cow. This is a higher average than in any state except New Jersey. Although there were only 11 per cent more dairy cows in the region in 1924 than in 1919, the production of milk was nearly 25 per cent greater. More than half the dairy cattle in the region are in the Great Valley. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

in any other part of the United States, or of the world, for that matter. There were over 12,100,000 chickens in the region on January 1, 1925, and the farm value of the eggs produced in 1924 was over $30,000,000, while the value of the chickens raised was $12,000,000 more. The poultry industry ranks second to the dairy industry in value of products. Unlike all other farm animals, there are more chickens in the Coast Sonoma County there were over 3,200,000 chickens on January 1, 1924 (Fig. 243). This is nearly three times as many as in any other county in the United States, except Los Angeles County, where there were about 1,800,000. These two counties had 5,000,000 chickens, or 40 per cent of the total in the entire region. There were 3,125,000 chickens in the Great Valley in 1924, nearly 5,500,000 in the Coast valleys, and 3,500,000 in Southern California. Although there are over a million people in the San Francisco Bay cities, and an-

tenth of the hogs of California are on one ranch in San Bernardino County, fed almost exclusively on garbage.

other million in the Los Angeles district, the production of eggs now exceeds the domestic demand, and eggs are shipped as far east as the Atlantic Coast. The large production near shipping points combined with a splendid marketing organization enables Petaluma eggs to arrive in New York City in such fresh condition as to bring the highest prices.

The bee-keeping industry is also as highly, if not more highly, developed in California than in any other state. In production of honey California leads all the states, and was exceeded in number of hives in 1919 only by Texas and Tennessee (Fig. 244). The greatest production is in Southern California, but the San Joaquin Valley also produces large quantities. The bee industry is associated with the fruit industry, as the bees are needed to fertilize the blossoms of many trees; but on the other hand, the abundant fruit blossoms, as well as the alfalfa blossoms and the various wild flowers, also provide food for the bees. Many bee keepers live in cities or villages and have the hives scattered for miles around—in a remote corner of a farm, in a national forest, and even in the open desert. The production of honey in the region ranges normally between 10,000,000 and 15,000,000 pounds.

Although California has gone farther, probably, than any other state in adopting the farm tractor, horses and mules still ranked next to cattle in aggregate value in 1924. There were 300,000 in the Subtropical Crops Region on January 1 of that year, of which only 15,000 were under two years old. In 1910 there were nearly 40,000 colts of this age. In other words, the production of colts has almost stopped. About 55 per cent of the work stock (two years old and over) were in the Great Valley, and the remainder were equally divided between the Central Coast Ranges and Valleys and Southern California. But, less than half of the 26,300 tractors in the Region in that year were in the Great Valley, while over a third were in Southern California. Replacement of horses by tractors appears to be proceeding more rapidly in Southern California, where the farms are much smaller than in the Great Valley. This may be owing partly to the increasing number of farms in Southern California. The adaptation of the tractor to the small acreage of many truck and fruit farms has been remarkable.

The number of horses in the region declined about 22 per cent between 1920 and 1925, and mules 12 per cent. In 1929 the estimates of the U. S. Department of Agriculture indicate a further decrease since 1925 of 15 per cent for horses and 10 per cent for mules. How long this replacement of work stock by tractors and automobiles will continue cannot be foretold, but the very few colts being raised indicates that it will continue for several years at least.

### SYSTEMS OF FARMING

In no other region in North America is agriculture so highly specialized as in the Pacific Subtropical Crops Region. The systems of farming are almost as numerous as the crops. However, it is possible to group these systems into eight classes as follows: (1) fruit and nut farming, (2) vegetable growing, (3) sugar beet and bean production, (4) grain farming, (5) hay production and dairying, (6) beef cattle ranching, (7) sheep grazing and fattening, and (8) poultry and egg production. This is an

extraordinary number of major systems to be found in a region having only 122,000 farms, only one half as many as Ohio or Missouri.

Fruit farming should be further classified into citrus fruit orcharding, deciduous fruit production, grape growing, and nut farming. Citrus fruit orcharding is often more than a system of farming; it is a form of

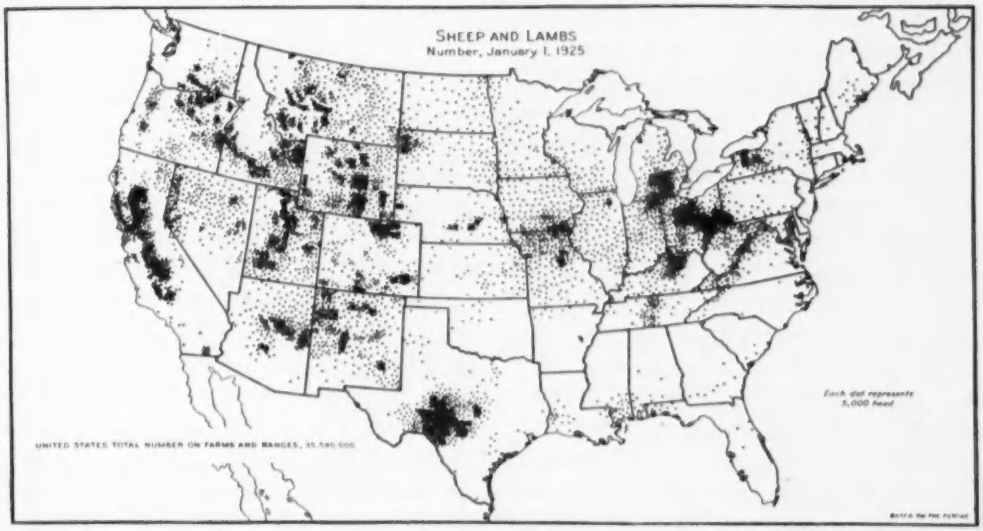



FIGURE 242.—Nearly all the sheep in the Pacific Subtropical Crops Region were found by the Census enumerators in the Great Valley on January 1. In the summer season some of these sheep will be grazing in the mountains that almost surround the valley. The northern (Sacramento) portion of the Great Valley is one of the leading early lamb-producing areas in the United States. Compared with dairy cattle, sheep are relatively unimportant in California, being reported on less than 6,000 farms in the state in 1925, as compared with 60,000 farms for dairy cows. (Map from 1928 Yearbook, U. S. Dept. of Agr.)

recreation and a manner of life for many growers. Over 22,000 farmers reported orange trees and 11,000 reported lemon trees in 1925, which gives an average of a little over 8 acres of oranges, but less than 4 acres of lemons, per farm reporting. In the Southern California counties, where the citrus production is very important, the average area of land per farm is over 100 acres, of crop land 42 acres; but the most frequent sizes of farms, according to the census, are those of 3 to 9 and of 10 to 19 acres, with farms of 20 to 49 acres almost as numerous. The farms average in value $300 per acre, but fruit farms usually range from $1,000 to $2,000 an acre. The value of orange orchards per acre is still greater. The average value of farms ranges from $25,000 to $70,000, varying with the county. A ten- to twenty-acre citrus orchard, therefore, is as large, measured in value, as a 100- to 200-acre farm in most parts of the Corn Belt. The amount of labor required for operation is also often as large, and at picking time may be larger. But, there is almost no livestock, except horses, and these are being replaced by tractors.

The deciduous fruit farms average a little larger in area, but less in value than the citrus farms. In Santa Clara County, for instance, the most frequent sizes of farms are those of 10 to 19 and 20 to 49 acres, with an

average of 25 acres of crops, of which probably 15 acres are fruit, mostly prunes, peaches, pears, and apricots, according to locality and individual preference. The average value of farms in 1925 was $25,000, but the orchard acreage would average nearly $1,500 an acre. The vineyard farms are still larger, commonly 20 to 49 acres in size, but average in value only $15,000 to $20,000. In the typical fruit farm most of the land is in fruit, except that occupied by the house and a small barn or garage. The nut farms vary greatly in area, but would average, probably, about the same acreage and value as the deciduous fruit farms.

Vegetable production, like fruit production, is generally a specialized system of farming. The average area per farm is from 15 to 40 acres, varying with locality, and the average value of the farm is $10,000 to $25,000. The average area of cantaloupes per farm in California in 1924 was 17 acres; of lettuce, 12 acres; of potatoes, 10 acres; and of tomatoes, 7 acres. Many farms may grow two or more vegetables and some farms have hundreds of acres of truck crops and may use a half dozen tractors. The production of lettuce and cantaloupes especially has become highly mechanized, and some growers have as high as 2,000 and even 3,000 acres of these crops. Nevertheless, the amount of labor employed per acre is even greater for many vegetable crops than for fruit crops.

The sugar beet and bean farms average much larger, the area of sugar beets per farm in the state being nearly 100 acres, and of beans over 40 acres. In Ventura County, where both these crops are important, the average area of crop land per farm is 90 acres, and the average value of land and buildings per farm is $70,000. Some farmers produce both sugar beets and beans. The sugar beet acreage has declined greatly in recent years, owing in large part to the low price of sugar.

Grain farming is the most extensive system of crop farming in the region. The grain is mostly non-irrigated and is now grown on soils less highly esteemed for fruit and vegetables, or for which water is unavailable. The average area of wheat per farm reporting in 1924 was about 150 acres, and of barley over 150 acres. Some of the grain farms contain over 1,000 acres. These farms are usually devoted very largely to grain, but often fruit also is grown.

The major dairying area is the Great Valley, with secondary areas in the Los Angeles and San Francisco Bay districts (Fig. 241). Hay and dairying are usually associated in California, as they are in the Northeastern States. The average area in 1924 of alfalfa per farm was 24 acres; of grain hay, 32 acres. The alfalfa is cut every six to ten weeks throughout the year, but the grain hay only once, as the small grains are annual plants. Some farmers grow both hays, but probably not a majority. The average hay farm would consist of 25 to 40 acres of hay, and many would have as much or more grain. The average number of cows milked per farm having cows is 9, but the commercial dairy farms would probably average twice as many cows per farm as this. Nearly half of the milk produced in the region is separated and the butterfat sold to butter factories, while less than a third is sold as market milk, mostly for domestic use. The remainder is sold as cream, made into

ice cream, cheese, condensed milk, and other products, or used on the farm. More generally, perhaps, than in any other part of the United States, dairying in California is a year-round industry. The production of milk per cow in 1924 was 630 gallons, according to the Census—higher than in any other state, except New Jersey. The year 1924 was very dry and probably 700 gallons per cow (6,000 pounds) is nearer the average.

Unlike dairying, which is primarily an irrigated land industry, beef cattle ranching is found largely on the unirrigated lands, both in the Great Valley and in the Central Coast Area. Many of the cattle men have hundreds of head of stock that graze over thousands of acres, but the average number of beef cattle per farm reporting was only about 80 in 1925. This is not enough to provide a comfortable living, of course, in the average year. Although the cattle are mostly grazed in the hills and dry valley lands, especially during the moist winter period, they are likely to be moved into the irrigated portions of the valleys for fattening on alfalfa and grain prior to slaughter. Many cattle ranches have some irrigated land, and most of them grow 50 to 100 acres or more of dry-land grain, largely barley.

Sheep production is, perhaps, even more dependent on grazing the dry lands. The sheep industry of the region is almost confined to the Great Valley and the margins of the Sonoma Valley (Fig. 242). In summer, however, many of the sheep will be found grazing in the mountains. In the winter, when the census was taken, the sheep were nearly all in the valley feeding on alfalfa and grain, and also on the stubble fields and natural pastures, which have turned green after the winter rains. Sheep farming, in the past, was more pastoral than agricultural, and a sheep man might have an "outfit" of a wagon, tent, and other equipment, rather than a farm. However, the development of the winter lamb industry as well as the need of having assured feed and the requirement for grazing in the national forests that permittees have improved ranch property, has caused the sheep industry to become sedentary and a sheep farm in the Sacramento Valley is now likely to consist of 50 to 100 acres or more of grain, and a similar acreage of alfalfa or grain hay, while commonly additional feed is purchased. There were only 4,000 farms in the region reporting sheep in 1925, and the average number per farm reporting was only a little over 500 head. The typical sheep "outfit," however, has from 1,000 to 2,000 head in a band, and may include several bands.

The poultry industry, unlike the sheep industry, is a very intensive type of farming, which has developed to an extraordinary degree in Sonoma and Los Angeles counties and to a less extent in other parts of the state. There were somewhat over 5,000 farms in each of these counties that reported chickens in 1925, and the average number of chickens per farm was over 300 in Los Angeles County, and over 600 in Sonoma County. Many farms in both counties, however, had only a few chickens, the typical poultry farm having from 2,000 to 4,000. The poultry farms are like manufacturing plants in that they occupy only a few acres of land and buy most of the feed used (Fig. 243). The days are lengthened in winter by electric lights so the hens will eat more feed and thus be

able to produce more eggs. Trap nests are commonly used and egg laying records kept for the better hens as a basis of breeding up the stock. Probably no farm industry has utilized more fully the discoveries of science and various devices and inventions than the poultry industry, especially in California, and no farming industry in the region has made more rapid progress.

In no other part of the world, probably, is agriculture so specialized and so diverse as in the Pacific Subtropical Crops Region. Every grain crop reported by the Census as grown anywhere in the United States is also reported in California; every kind of hay; every vegetable grown for sale, except horseradish; every fruit, except kumquats, pineapples, mangoes, sugar apples, and sapodillas; every other crop, except sugar cane, maple trees tapped for sugar, castor beans, chufas, ginseng, peppermint, and teasels. On the other hand, it is the only state to report cassava and citrons. No state compares with it in variety of crops.

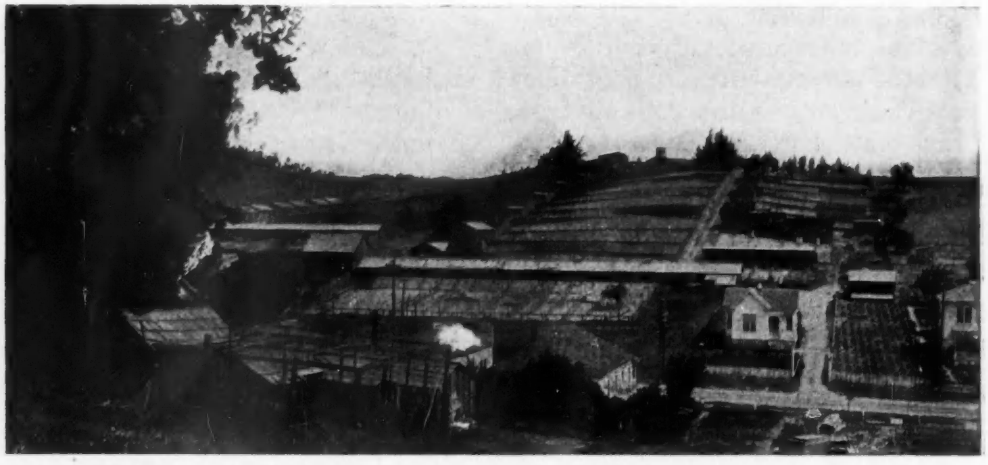


FIGURE 243.—A poultry breeding plant operated by one of the leading hatcheries in the Petaluma district. Cockerels produced on this farm are used to head up the flocks that supply the hatchery with eggs. (Photo from Dairy and Poultry Division, U. S. Bur. of Agr. Economics.)

Agriculture in the valleys of California is characterized by the Mediterranean fruits, but also, locally, by cotton from Mexico, the grain sorghums from Africa and India, rice from the Orient, and sugar beets from Northern Europe. Agriculture in the mountains is based on timothy and clover hay, as in the northern United States, and along the cool coast apples and beans are grown, as in Michigan and New York. Likewise, with livestock—beef production, dairying, wool and lamb production and, outstandingly, egg production and honey production—all are highly developed. Only in the production of pork and lard does California fail to occupy a conspicuous place. This diversity is owing partly to the variety of climatic conditions, but the diversity of the agriculture exceeds the diversity of the climate. Driving along a road in Southern California, it is quite likely there will be found in succession an alfalfa and dairy farm, a walnut orchard, an orange grove, a poultry farm, and a truck farm.

This extraordinary specialization in intensive systems of farming involves a large expenditure for labor and, in less degree, for feed. Far more money is paid as wages to farm labor in California than in any other state—about as much as Iowa, Missouri, Kansas, and Nebraska combined (Fig. 245). There was also a greater expenditure for feed in 1924, according to the census, than in any other state, except New York. The average expenditure for labor on the 85,000 farms reporting such expenditure was about $1,250 per farm; and for the 80,000 farms reporting expenditures for feed the average was $660 per farm. Only Arizona had any comparable expenditure per farm for labor, and only Massachusetts, Rhode Island, and New Jersey had a greater expenditure per farm for fertilizer and manure. Sixteen thousand farmers, mostly citrus growers and truck growers, reported an expenditure for fertilizer of $8,371,000 in 1924, an average of $525 per farm.

Agriculture in California is commercialized to a greater extent, probably, than in any other state. Being commercialized, it is organized undoubtedly to a greater extent than in any other state. This organization is on a commodity basis, but there is also a splendid State Department of Agriculture, a State Research Council, and a State Development Board, as well as highly efficient chambers of commerce in the principal cities. Moreover, the University of California is the largest state university in the nation, and it has a larger research staff in agriculture than that in any other state. All of these organizations pull together, and they are accomplishing great tasks.

## SIZE AND TENURE OF FARMS

The Pacific Subtropical Crops Region possesses both the largest and the smallest farms in the nation, measured by area; and probably measured by value of products also. The large farms can be traced to the old Spanish land grants made when California was a Spanish colony. After the acquisition of California from Mexico, many of these estates were purchased from the Mexican owners by American speculators, and operated for a longer or shorter period as cattle ranches. Most of these "ranches" and mission properties have been divided into farms and sold, but a few remain, and some of these large estates are highly developed. The Census of 1925 enumerated 3,233 farms in the Subtropical Crops Region exceeding 1,000 acres in area, and of these nearly 500 contained 5,000 acres or more. There are several estates that exceed 100,000 acres.

On the other hand, nearly two-thirds of the farms in the Region contain less than 50 acres, a proportion that is higher than in any other agricultural region.[18] The proportion is about 75 per cent in Southern California, where most of the farms are fruit, vegetable, or poultry farms, and is only a little over 60 per cent in the Great Valley, where, in addition to the fruit and vegetable farms, there are many hay and dairying farms, cattle and sheep ranches. Both in

[18] In Southern New England and New Jersey, also in the states south of the Potomac and Ohio rivers, about half of the farms have less than 50 acres of land; but in New England many of these farms are residences of city workers from which the products are of little value, while in the "Old South" probably most of these small farms are holdings of croppers, who are paid wages by the land owners in the form of a share of the crops, and hence are classified by the Census as tenant farmers.

number and in proportion, large farms are most numerous in the Great Valley and least numerous in Southern California, as is shown in Table II.

Although two-thirds of the farms are under 50 acres in area, these farms include only about 5 per cent of the farm land and less than 20 per cent of the crop land. Nearly 25 per cent of the crop land is in farms of 50 to 175 acres in area, 20 per cent more in farms of 175 to 500 acres and 35 per cent in farms of over 500 acres in area. Over half the crop area, therefore, is in what might be called large farms (over 175 acres in area). Numerically, California is a state of little farms, but in productivity the big farms contribute probably as much as the little farms and are worth almost as much. Perhaps nowhere is there a better adjustment of the size of the farm to the varying capacities and abilities of farm operators.

The 47,000 farms in the Subtropical Crops Region under 20 acres in area (over one-third of all farms), average about 6 acres in crops, and less than 9 acres in all. They had an average value of land and buildings in 1925 of $10,000, of which the land constituted $7,800 and the buildings $2,200. The principal building is the house, which is typically a one-story "bungalow" of 3 to 6 rooms, and as the temperature drops below freezing only for an hour or two on an occasional winter morning, and the people live largely out of doors, the house need not be very well built. The 36,000 farms of 20 to 50 acres in area average 21 acres in crops and 30 acres in all, have an average value of $16,000, of which the buildings account for only $2,200—the same as on the farms under 20 acres. It will be noted that the value of the land per acre is only about 60 per cent as great as for the smaller farms. The 24,000 farms of 50 to 175 acres in area average 60 acres in crops and 100 acres in all, are worth on the average $26,400, but the farm buildings only $2,800. Finally, all the farms over 175 acres in area, about 21,000 in number, average 160 acres in crops and $61,000 in value, of which buildings account for $4,500. These figures make clear the small investment in farm buildings in the Region, in barns as well as houses, and the very great investment in land. The buildings represented only 12 per cent of the joint value of land and buildings in 1925. The average value of the land per farm is greater than in any other state, and is approached only by Iowa, where the crop acreage per farm is over twice as large. It would seem on the surface that the peculiar climatic conditions have given the land almost a monopoly value, but it may appear on further investigation that irrigation works and orchard development have cost almost as much as the present value of the land.

TABLE II

PACIFIC SUBTROPICAL CROPS REGION FARMS CLASSIFIED BY AREA, 1925

| *Sub-Region* | *Under 20 Acres* | *20 to 49 Acres* | *50 to 99 Acres* | *100 to 174 Acres* | *175 to 259 Acres* | *260 to 499 Acres* | *500 to 999 Acres* | *Over 1,000 Acres* | *Total* |
|---|---|---|---|---|---|---|---|---|---|
| Great Valley | 13,319 | 22,683 | 8,135 | 5,102 | 1,918 | 2,695 | 4,503 | 1,802 | 60,157 |
| Coast Valleys | 14,220 | 6,176 | 3,185 | 2,431 | 1,053 | 1,539 | 2,385 | 936 | 31,925 |
| Southern California | 19,815 | 6,670 | 2,527 | 2,291 | 869 | 1,208 | 1,814 | 495 | 35,689 |
| Total in Region | 47,354 | 35,529 | 13,847 | 9,824 | 3,840 | 5,442 | 8,702 | 3,233 | 127,771 |

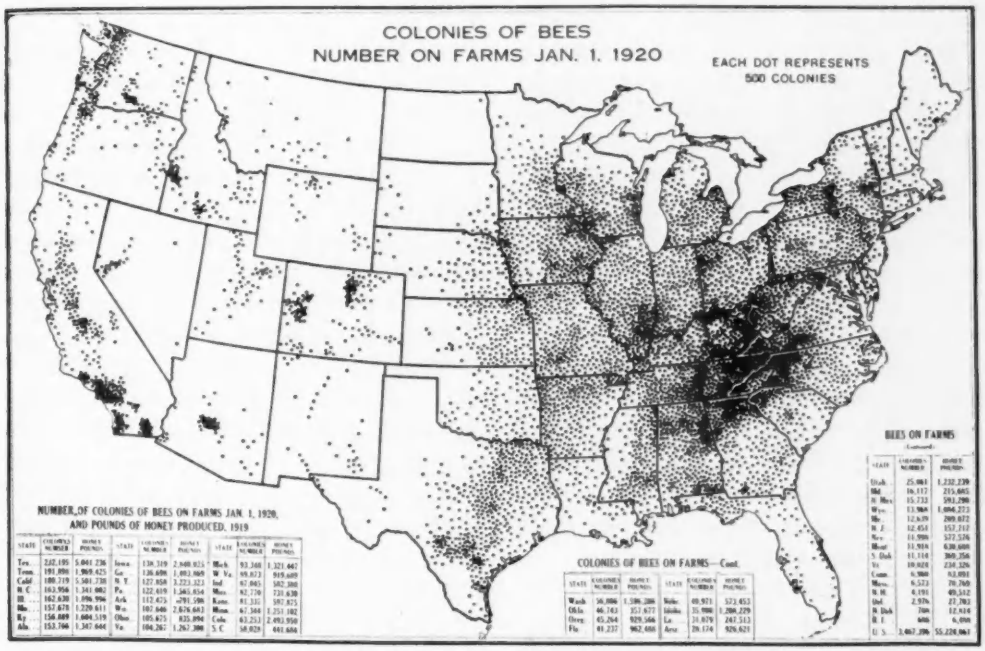



FIGURE 244.—Although California had less than a third as many hives of bees as the southern Appalachian center shown on the map, extending from eastern Kentucky to northern Georgia, the California bees produced more honey in 1919 than the bees in the eastern area. The average production in California was over 30 pounds per hive, in the Appalachian area less than 10 pounds. California is the leading state in honey production. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

Unlike most regions where land values are high, there are few tenant farmers in the Pacific Subtropical Crops Region—less than 14 per cent. For the United States as a whole the average in 1925 was 38.6 per cent. The crops grown and the specialized systems of farming help to explain the low percentage of tenancy. A fruit orchard can seldom be safely entrusted to a tenant. He might do more harm in one year than the owner could repair in 20 years. Moreover, the prices of the products, and consequently the returns, fluctuate widely and not infrequently result in serious losses, as well as in extraordinary profits. Likewise, with dairying and egg production, technical experience is required as well as heavy investment on the part of the farmer. This is equally true of the beef cattle ranches. These systems of farming everywhere in the United States have a low percentage of tenancy. When an owner cannot operate such a farm himself, he often prefers to hire a manager, in order that he may continue to exercise a large measure of control. There were over 5,500 farms operated by managers in the Region in 1925, or 4.5 per cent as compared with 0.6 per cent for the United States.

Nearly half of the farms operated by owners are mortgaged (no data for tenant farms), and the debt is about one-third of the value of the farms. This is a larger proportion of the farms, but a lower ratio of debt to value than for the United States as a whole.

In brief, the Pacific Subtropical Crops Region is characterized by very valuable farms, mostly small, but many large and some very large,

in which most of the investment is in the land and the trees on it. Nearly half of the farms are mortgaged. Most of the farmers live in small, cheaply built houses, which, however, are commonly provided with modern sanitary and labor saving devices. Only the dairy farms and cattle ranches have barns of any size —there is little need for them.

## THE PEOPLE

California has been the melting pot of Americans and, in addition, has tried to fuse into its citizenship a large assortment of aliens. More people living in California in 1920 were born in other states than were born in California—nearly 1,400,000 in all. About 80,000 of these residents of the state were born in New England, 100,000 in New York, 70,000 in Pennsylvania, 90,000 in Ohio, 60,000 in Indiana, 140,000 in Illinois, 50,000 in Michigan, 45,000 in Wisconsin, nearly 90,000 in Iowa, 105,000 in Missouri, over 60,000 in Kansas, and 50,000 in Texas. Kentucky, Tennessee, Minnesota, Nebraska, and Colorado contributed between 20,000 and 40,000 each. Only the old Cotton Belt States east of Texas are poorly represented. There are far more emigrants from other states living in California than is the case in any other state. Southern California in particular has been populated largely by these emigres. Los Angeles and other cities have flourishing Ohio, Illinois, and Kansas societies, which meet monthly, quarterly, or annually for a social evening. The California-born, not to be outdone, likewise have a native sons' society of which they are quite proud.

On the other hand, a smaller proportion of the people born in California have moved to other states to live (10 per cent) than is true of any other state. Not only the climate, which encourages outdoor life throughout the year (though it becomes to some rather monotonous) and lowers the cost of living, but also the high wages for manual labor and the excellent facilities for education and recreation, have been important factors in holding Californian-born at home.

California early adopted the automobile and took the lead in the building of good roads. It has a larger mileage of hard surfaced roads per thousand population than any other state, except Delaware and Nevada.[19] It was one of the first states to use and improve the farm tractor. The famous "caterpillar" type was invented and developed in California. There are now more tractors per 1,000 horses and mules in California than in any other state. The farmers of California were the first to organize successful coöperative marketing associations, and now probably half of the fruit of the state and many other agricultural products are sold through coöperative organizations. These maintain efficient agencies not only in many eastern cities, but also in Europe and Asia. The proportion of the farm houses having water piped into the house is higher in California than elsewhere in the United States except in New England; and the proportion having radio outfits is also higher than elsewhere, except in a few New England and Corn Belt states.

This spirit of progress is shown also in the State's educational and

[19] U. S. Bureau of Public Roads figures for 1928 for bituminous Macadam, sheet asphalt, bituminous concrete, Portland cement, vitrified brick, and block asphalt, wood and stone. California has 5,600 people to the mile of such roads.

research institutions, as will be noted later. It is this spirit of the people fully as much as the natural resources, which are not more abundant than elsewhere, that has held the Californians at home and attracted immigrants not only from other states, but also from the ends of the earth.

### NATIONS AND RACES

Over 750,000 residents of California (22 per cent) were foreign born in 1920. Nearly 60,000 were born in Canada, 80,000 in Great Britain, and over half as many more in Ireland. Scandinavia contributed over 60,000, Germany and Austria 80,000, France 20,000, and Switzerland 16,000. Italians numbered 90,000, Portuguese 25,000, plus 9,000 from the Azores, Spaniards 11,000, and Greeks 10,000. There were 27,000 Russians in the state, 7,000 Poles, 7,000 from Jugoslavia, and 5,000 from Hungary, while Armenia and Syria contributed 7,000. From the Far East came 2,000 from India, 4,000 from the Philippines, 20,000 from China, and over 50,000 from Japan. In 1920 Mexico had contributed 90,000. The number of Mexicans in California is now much larger, probably 400,000 to 500,000, as 65,000 Mexican children were enrolled in the public and Catholic schools in 1927.[20] Many of these Mexicans, of course, were born in the United States. Central and South America have sent 4,000 people to live in California, Australia 4,000, Hawaii 8,000, and other islands of the Pacific (Samoa and Tahiti) nearly 2,000, while the West Indies contributed 1,300, and Africa 700.

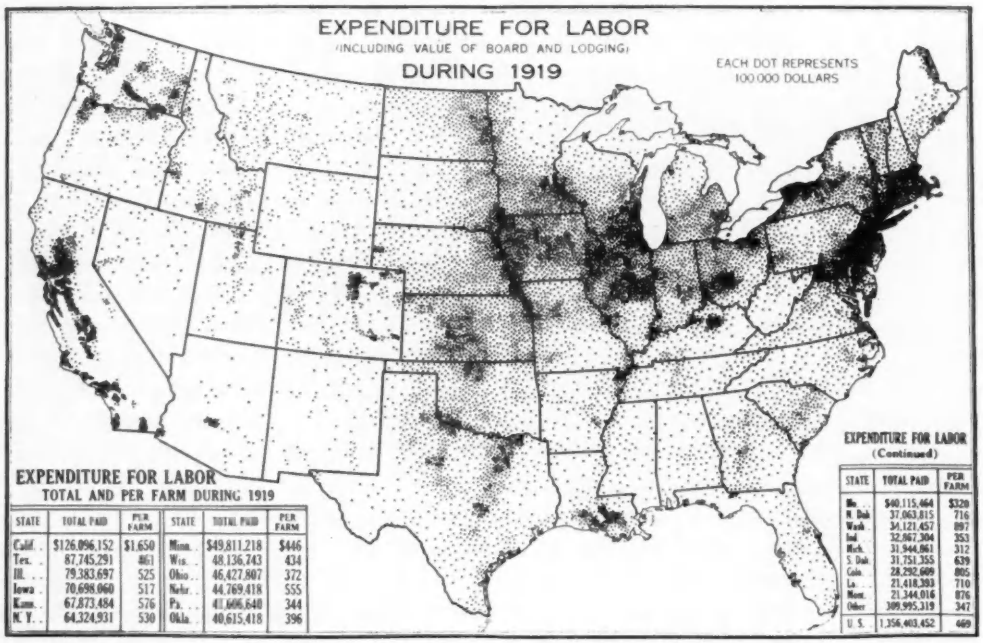
As these immigrants have risen in economic condition, other laborers willing to do manual work and at a lower wage, have been encouraged to come to the state. Not only Mexicans, but also Philippinos, have been coming in large numbers, many of them without families, and serious social problems are developing.

Nevertheless, California is the new New England. From the days of the Gold Rush and the "Forty Niners" until the present, the people of New England ancestry, not only from New England, but also from New York, Michigan, northern Ohio and Illinois, Iowa, Nebraska, and Kansas have sought their fortune or freedom from cold winters in the balmy or blistering climate of California. The climate, the magnificent scenery, and the charming Spanish tradition have also attracted many artists, authors, and other people of culture to the state, as well as retired business and professional men. Of the 1,681 people living in California listed in "Who's Who" (California ranks fifth among the states), 1,246, or nearly three-fourths, were born outside the state, mostly in New England, the other northeastern states, and the north central states.

### EDUCATION

Such people are interested in schools and the amenities of modern life. The California public school system ranks among the best of the state school systems. Thirty public high schools and three private junior colleges now offer instruction equivalent to that in the freshman and sophomore years in the universities, and both of the leading universities in the state (Stanford and the University of California) are considering doing away with these years in their courses of study and combining the

[20] Taylor, Paul S., "Mexican Labor in the United States, Racial School Statistics, California, 1927." University of California Publications in Economics: Vol. 6, no. 4, Berkeley, 1929.




**EXPENDITURE FOR LABOR**
**TOTAL AND PER FARM DURING 1919**

| STATE | TOTAL PAID | PER FARM | STATE | TOTAL PAID | PER FARM |
|---|---|---|---|---|---|
| Calif. | $126,096,152 | $1,650 | Minn. | $49,811,218 | $446 |
| Tex. | 87,745,291 | 861 | Wis. | 48,136,743 | 434 |
| Ill. | 79,383,697 | 525 | Ohio | 46,427,807 | 372 |
| Iowa | 70,698,060 | 517 | Nebr. | 44,769,418 | 555 |
| Kans. | 67,873,484 | 576 | Pa. | 41,606,640 | 344 |
| N. Y. | 64,324,931 | 530 | Okla. | 40,615,418 | 396 |

**EXPENDITURE FOR LABOR**
**(Continued)**

| STATE | TOTAL PAID | PER FARM |
|---|---|---|
| Mo. | $40,115,464 | $320 |
| N. Dak. | 37,063,815 | 716 |
| Wash. | 34,121,457 | 897 |
| Ind. | 32,867,304 | 353 |
| Mich. | 31,944,861 | 312 |
| S. Dak. | 31,751,355 | 639 |
| Colo. | 28,292,609 | 865 |
| La. | 21,418,393 | 710 |
| Mont. | 21,344,016 | 876 |
| Other | 309,995,319 | 347 |
| U. S. | 1,356,403,452 | 469 |

FIGURE 245.—The expenditure for farm labor is greater in California than in any other state. It was greater in 1924 than in New England, New York, and New Jersey combined, or in Ohio, Indiana, Illinois, and Missouri considered jointly. The average expenditure per farm reporting was $1,650 in 1919, including value of board and lodging, and $1,240 cash per farm in 1924. In most states the average expenditure for labor per farm is not half so great. (Map from 1921 Yearbook, U. S. Dept. of Agr.)

junior and senior years of work with the graduate years in courses largely of professional character.

The University of California is the largest state university in North America, both in enrollment of students (19,000 in residence at Berkeley, Davis, and San Francisco, and at the Southern Branch in Los Angeles), and in expenditure of funds ($12,614,000 for all purposes in 1927–1928). The enrollment at Stanford University is about 4,550, at the University of Southern California is 11,100, and at other colleges and universities 11,000, plus 8,400 in junior colleges, a total of 54,000 students in the higher institutions of the state. This is a larger number of students than in the universities and technical schools of Great Britain, which has a ten-fold greater population.

For every 100 children who enter the first grade of school, 82 complete the elementary school, 79 enter high school, 35 graduate from high school, 27 enter college or university (including students from other states, but excluding California citizens in school outside the state), and 7 graduate from college or university.[21] These proportions are a half higher than in the United States as a whole. The number of students in graduate or professional schools in California is about equal to the number graduating from college. However, several graduating classes may be represented in these graduate schools, and some graduate students come from other states.

[21] These data on university and school enrollment in California were courteously provided by Dr. Frank M. Phillips, Statistician, U. S. Bureau of Education.

The proportion of the children 7 to 13 years of age attending school in California in 1920 was 93.7 per cent, which was 3 per cent higher than in the United States as a whole, but was lower than in 22 states, located mostly in the Northeastern and the Rocky Mountain regions. The large proportion of Mexican and other foreign immigrants and the opportunity for agricultural work during the winter accounts in large measure for this relatively low school attendance. On the other hand, the proportion of persons 18 to 20 years of age attending school was higher in California (21.9 per cent) than in all the other states except four—Oregon, Nevada, Utah, and Idaho. It was twice as high as in Pennsylvania or Louisiana, and almost twice as high as in New York, Illinois, Michigan, or Georgia.

### *Illiteracy*

Nearly four per cent of the people of California in 1920 were unable to read or write. But for the native whites of native parentage the proportion was only 0.4 per cent; for those of foreign parentage 0.5 per cent, while for the negro it was 5.6 per cent and for the foreign-born whites it was 10.7 per cent. Although there were 17 states having a lower illiteracy rate than California, there were only three states (Massachusetts, North Dakota, and Washington) for which the rate was lower for native whites of native white parentage. One of the great tasks of the California school system is to educate the children of its foreign-born residents. This is especially difficult in Southern California, where Mexican children constituted, in 1927, about 16 per cent of the total enrollment in the elementary schools, and Japanese children 2.2 per cent. However, the Japanese children are no problem, for they are usually bright students and anxious for an education.

### RELIGION

Over 1,500,000 people in California were members of a church in 1926, or about 40 per cent of the total population. Of the adults nearly half were church members. About one-third of the church members 13 years of age and over were Catholics (510,000), and nearly two-thirds (158,000) of those under 13 years of age. As there are 65,000 Mexican children enrolled in the public and Catholic schools, it appears probable that a large proportion of this juvenile Catholic membership is Mexican.

The leading Protestant denomination is the Methodist, whose membership totaled about 150,000 in 1926. The Presbyterians are two-thirds as numerous, while the Protestant Episcopalians and the Baptists each number about half as many. There are nearly 50,000 Disciples of Christ and 43,000 Congregationalists; also nearly 40,000 Lutherans of various kinds and 26,000 Mormons. Adventists numbered 20,000 and Christian Scientists 16,000. The membership of Jewish congregations numbered 123,000. There are 50 other religious denominations listed in the Census, besides 41 churches classified under the heading "all other denominations," but none of these had over 10,000 members.

It is to be expected that where a people are gathered from the ends of the earth there will be great diversity of religious faiths, but doubtless the number in California is augmented by the partial idleness of the people of wealth and culture who

have retired to California and find rest or recreation in some new or novel belief. In Los Angeles, as in ancient Athens, there are monuments to the unknown God, and if Saint Paul should visit this great city, he would find that many of its people, like the Athenians of old, are very religious.

### TREND OF POPULATION

The growth of population in California has been extraordinarily rapid. From 92,600 people in 1850 to 1,485,000 in 1900 and 3,427,000 in 1920, the rate of gain exceeded 40 per cent each decade, except from 1890 to 1900. Only two states had a more rapid rate of gain than California between 1910 and 1920, Arizona and Montana, and these are states of relatively small population.

The growth of the farm population has likewise been rapid right up to the present, and in this regard California is almost unique among the states. Statistics of farm population were secured for the first time by the census of 1920, but the total population, total families, and number of farms, or farmers, are available since 1850; also rural population and rural families can be calculated. By calculating the average size of the rural family for 1850 to 1880, and multiplying the number of farms by rural population per family, it is possible to approximate closely the changes in farm population during the past 75 years. These changes are compared with the changes in total population in Table III.

It will be seen that the farm population increased at a faster rate than the total population from 1870 to 1900, but that between 1900 and 1910 the farm population increased only about 20 per cent, as compared with 60 per cent increase in total population. From 1910 to 1920 farm population increased about 24 per cent, while total population increased 44 per cent. From 1920 to 1925 the farm population increased probably between 13 and 15 per cent, which is very remarkable, not only because of the high rate of increase, but also that any increase should have occurred while all other states except those in Southern New England, South Dakota, Nevada, and Washington were experiencing a decrease. For the United States as a whole, the decrease in farm population in the five years was over 6 per cent.

The importance of immigration to the progress of population in California is indicated by the fact that less than half of its people were born in the state. The trend of the birth-rate suggests that this proportion may be even greater in the future. The births in 1928 had fallen nearly to 18.3 per thousand population, which was considerably lower than the average for the nation. On the other hand, the death rate was higher than in any other state, except New Hampshire. This is not owing to unhealthful conditions, the infant mortality being among the lowest in the nation, but to the large number of old people and invalids who have moved to the state to spend their declining years. More than 6 per cent of the people of the state were over 65 years of age, according to the 1920 census, as compared with 4 per cent for the entire United States; while only 8 per cent were under 5 years of age, as compared with an average of nearly 11 per cent for the nation as a whole.

Between 1924 and 1928 the birth-rate in California fell from 22.2 to 18.3. Since a birth-rate of about

16.6 is necessary to maintain in a stationary condition a population which is not being augmented by immigration, (and which has an average age at death of 60 years, as in California) it appears that after the present generation of children reach maturity, if not before, California will be dependent on immigration into the state for any increase of population. Indeed, with a birth-rate already lower than that of France, the state may soon (in 20 to 30 years) be dependent on other states or foreign countries to keep its population from declining.

In this respect California is not different from most other states, except in degree. The birth-rate in nearly all parts of the United States, and also in Northern Europe, has declined very rapidly since 1921, but in California the decline has been exceptionally rapid and has reached a lower point than in most states.

FIGURE 246.—A typical California home, one story and close to the ground because the rainfall is light and the soil is dry, ventilating windows beneath the roof because the sun is hot, thick walls because the summer days often are warm, placed among the live-oaks because of the shade and the beauty, young orange trees in the foreground because the winters are mild, hills in the background because there is almost no land in the Pacific Subtropical Crops Region more than a few miles (an hour's auto ride) from the mountains—in all a delightful place to spend the winter, the vacation days, and the declining years of life. Particularly is this true of the coast for a few miles back from the ocean, where it is usually cool in summer as well as in winter. (Photo from Los Angeles Chamber of Commerce.)

In North America there are less than 150,000,000 people, while across the Pacific, in the Orient, there are probably 1,000,000,000 people. Yet, the area of land cultivated and the aggregate agricultural production is similar in magnitude in North America and the Orient, and likewise the

TABLE III

CALIFORNIA—TOTAL POPULATION AND ESTIMATED FARM POPULATION, 1850–1924

| Year | Population* Total | Per Cent of Increase | Total Number of Families* | Total Population per Family† | Rural Population per Family‡ | Number of Farms* | Estimated Farm Population Total§ | Per Cent Increase |
|---|---|---|---|---|---|---|---|---|
| 1850 | 92,597 | .... | 24,567 | 3.77 | 3.16 | 872 | 2,756 | .... |
| 1860 | 379,994 | 310.4 | 98,767 | 3.85 | 3.61 | 18,716 | 67,565 | 51.6 |
| 1870 | 560,247 | 47.4 | 128,752 | 4.35 | 4.08 | 23,724 | 96,794 | 43.3 |
| 1880 | 864,694 | 54.3 | 177,508 | 4.87 | 4.62 | 35,934 | 116,015 | 71.5 |
| 1890 | 1,213,398 | 40.3 | 245,710 | 4.94 | 4.73 | 52,894 | 250,189 | 50.7 |
| 1900 | 1,485,053 | 22.4 | 341,781 | 4.35 | 4.26 | 72,545 | 309,042 | 23.5 |
| 1910 | 2,377,549 | 60.1 | 563,636 | 4.22 | 4.21 | 88,197 | 371,309 | 20.1 |
| 1920 | 3,426,861 | 44.1 | 900,232 | 3.81 | 3.91 | 117,670 | 460,090‖ | 23.9 |
| 1925 | .... | .... | .... | .... | 3.89¶ | 136,409 | 531,008** | 15.4†† |

* As reported by the Census.

† Total population divided by number of families.

‡ Total population of state less population in places of 2,500 people and more, divided by total families in state less families in places of 2,500 and more.

§ Number of farms multiplied by persons per rural family; probably not quite large enough, except in 1925, as farm family is doubtless slightly larger than rural family, but fairly comparable from 1850 to 1920.

‖ The census figure is 516,770, but this includes an unknown number of farm laborers not living on farms nor in incorporated places.

¶ Farm population divided by number of farms, as reported by the Census.

** Population living on farms January 1, 1925, according to the Census.

†† Only a five-year period; but the figure is probably a little too large, owing to the farm family in 1920 being slightly larger, doubtless, than the rural family.

potentially arable land, 1,500,000,000 acres, more or less, in each continent. With such a difference in population pressure, a difference that is likely to increase rather than diminish, it would seem that the only reasonable alternative to the movement of population from Asia to America is the movement of food and other agricultural products from America to Asia, and the acceptance in return of industrial commodities. The inter-relation of the Pacific Peoples is the great problem of the world, and in its solution American farmers may find ultimately the solution of some of their most difficult problems also.

# THE FOREST OF DEAN IN GLOUCESTERSHIRE

*E. Muriel Poggi*

Geographer, University of Illinois

THE Forest of Dean is the name given to the part of Gloucestershire situated in the angle formed by the river Wye and the course of the lower Severn. It was once an important royal forest and it is underlain by a coalfield bearing the same name. It was the accepted opinion for many years that the South Wales and Forest of Dean Coalfields were originally united. Folding from the north and south took place in late Carboniferous times and gave the basin-like form to the two coalfields, and at a later period denudation along the Usk anticline separated the two fields. The area is formed almost entirely of Carboniferous rocks enclosing the Coal measures of the Forest (Figs. 1 and 3). It is doubtful if there is a perfect coal basin, forming a complete industrial unit, in such a small area, to be found anywhere else. The small size (roughly 9 x 12 miles) has made it possible to make a detailed study of the relief and structure, to visit the industrial towns and villages, to descend the coal mines and to wander through the remains of the beautiful forest which contributed to the "Hearts of Oak" of Henry VIII's navy, and to get into close touch with the inhabitants, whether they be "Free Miners" or Foresters, and to learn something of their history and the geographical conditions which have played such an important part in the development in what has been, until quite recently, a self-contained industrial unit.

The rocks surrounding the Coalfield form a rim which is highest in the west and north where it is marked by isolated hills, *e.g.* Ruardean Hill, Staunton Meend, and Howle Hill. On the east there is a well-defined escarpment facing east and continuing unbroken for five or six miles. On this eastern brink we have the ridges, Edge Hill and Staple Edge. Travelling south by road from Micheldean to Little Dean, the character of this *edge* is realized as it rises high on the right. So the Forest is practically enclosed by a rim of higher land except on the south, from which direction routes penetrate into the heart of the area, the valley of the Cannop Brook dividing it nearly in half.

## Structure

By referring to the geological map of the Forest area (Fig. 3) the outcrops of the following beds may be seen: In the center the Coal Measures and a layer of coarse sandstone called Drybrook Sandstone, which until recently was thought to be Millstone Grit. Then come beds of Carboniferous Limestone and Old Red Sandstone. These concentric layers are markedly unsymmetrical, there being much unconformity and much variation in the dip of the strata. The Millstone Grit of adjacent coalfields is absent from the Forest of Dean, and the Drybrook Sandstone is now known to represent the upper stratum of the Carboniferous Limestone. It is conformable with the limestone,

but unconformable with the overlying coal measures. This Drybrook formation does not extend in an unbroken rim round the coal; in fact, in the southeast the Coal Measures rest directly on the Old Red Sandstone, while in the northeast the Drybrook Sandstone is concealed for five or six miles, and the coal here rests on the Carboniferous Limestone (Fig. 3). On the east side of the coalfield where the Carboniferous layers dip steeply, they present correspondingly narrow outcrops (Figs. 3 and 6). On the western and northern margin where the dip is much less, the gentle undulations make the Carboniferous outcrop very broad (Figs. 3, 4, and 7).


FIGURE 1.—Map of England and Wales, showing the location of the Forest of Dean.

## INDUSTRY

To make a study of the industries of the Forest, Monmouth forms a good starting point; from that town we cross the river Wye by the fine old bridge and, following the Coleford Road, we pass round the north of Kymin Hill and up to Staunton Meend. So far the scenery resembles that of the country west of the Wye in the Red Land of Gwent, because we are still on the Old Red Sandstone plateau. But, from Staunton looking eastward we see the green line of the Forest, while immediately below lies the grimy village of Berry Hill, from which the straggling buildings link up with the chimneys and pit shafts of Coleford. The picturesque agricultural villages are left behind on the Old Red Sandstone; here on the Carboniferous Measures industry is the keynote of the district. Following the road south from Coleford and skirting the southern end of the Forest, we pass coal mining villages, quarries, lime kilns, and abandoned iron mines before reaching Lydney, the one port of the Forest. Here at the docks trucks are drawn up laden with

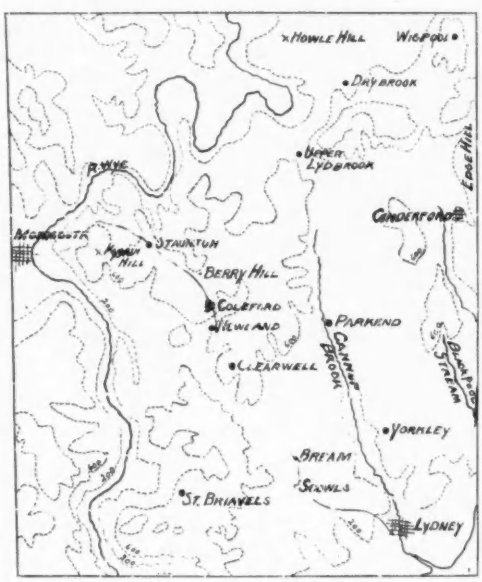



FIGURE 2.—Topographical map of the Forest of Dean area—200 and 600 foot contours are shown.

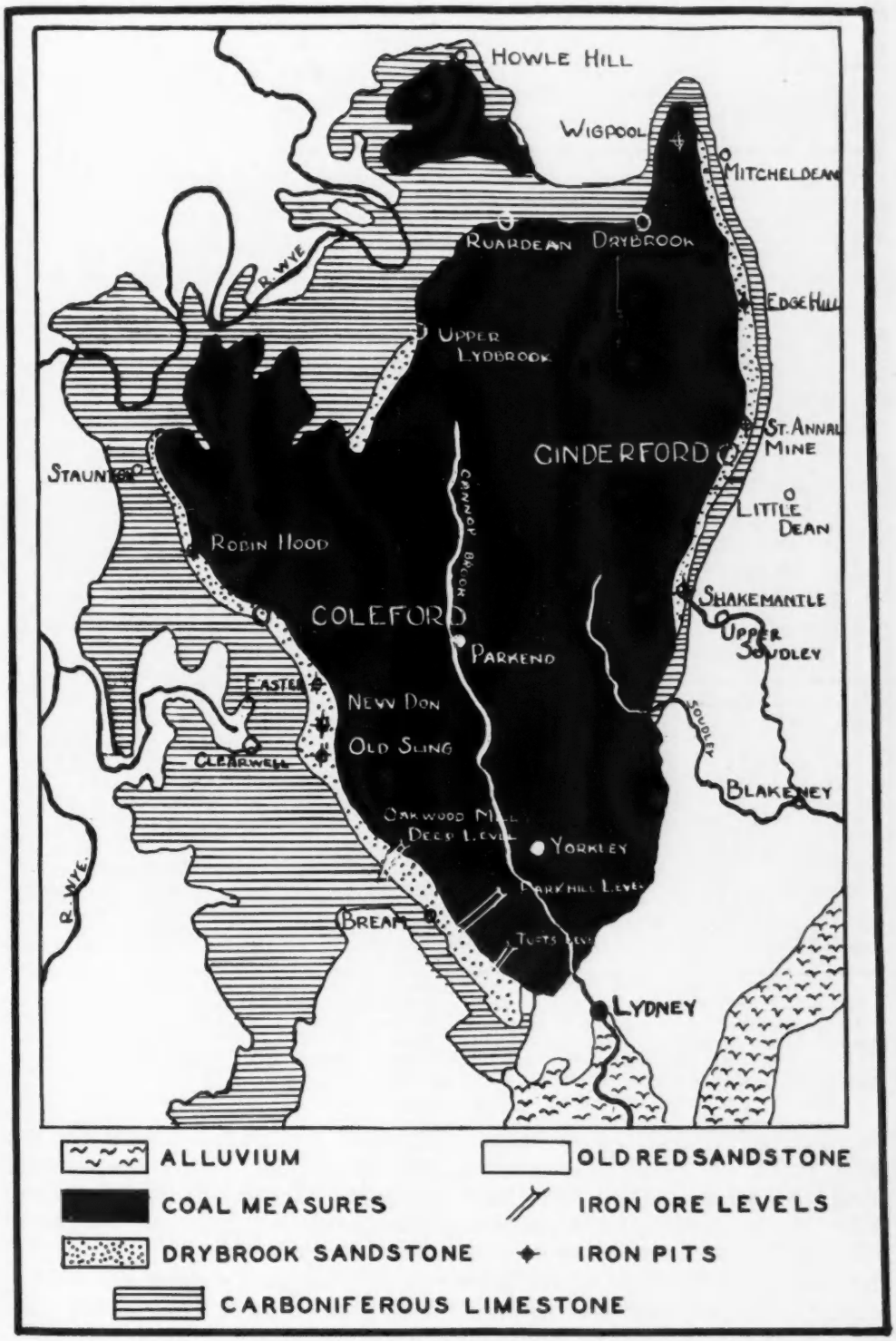



FIGURE 3.—Geological map of the Forest of Dean.

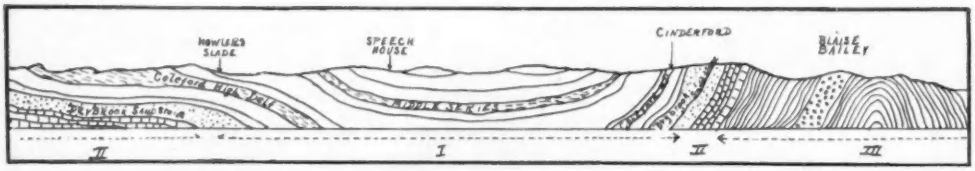



FIGURE 4.—Section across the Forest of Dean, from Howlers Slade to Blaise Bailey (see Fig. 3). (1) Coal Measures; (2) Carboniferous Limestone; (3) Old Red Sandstone and Conglomerates.

coal, forest stone, and timber, the products of industry in this small and isolated unit.

### IRON MINING

Mining has been carried on here for centuries. From the Miners' Laws of 1300 we find that the Miners' Court held its meetings at St. Briavels Castle, in the southwest; while a "regard" of the Forest taken in 1282 (Edward I's reign) records that there were 60 forges at work here, which appear to have supplied agricultural implements and horse shoes for the Gloucester fairs. But, the working of iron dates back to the time of the Roman occupation. There is unmistakable evidence that their work was promoted on a large scale. They worked underground and in "day workings," winding passages, open at the surface, called "Scowles" (corruption of Old English word crowll, meaning a cave). One of the best examples of these can be seen near Bream close to the Lydney Road, and is known as the Devil's Chapel (Fig. 8). This is an extremely weird, yet beautiful, region. Vast caverns and pits have been hollowed out, and in the labyrinths worked among the rocks, the roots of the great beeches and yews which clothe the area are exposed resembling ghostly forms in the shaded hollows. Wild flowers and ferns abound in the iron-stained soil and rocks that line the passages and galleries. Some idea of the scope of the Roman workings may be gained from the fact that the smelting of their "cinders" yielded a considerable part of the revenue paid by the Forest to Edward I.

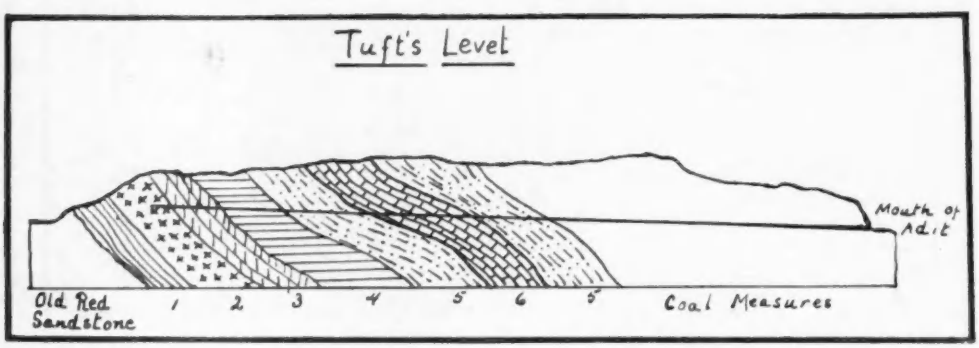



FIGURE 5.—Tuft's Level with entrance in the Cannop Valley. In the Bream-Lydney Area considerable quantities of iron ore have been won from the Drybrook Sandstones. Deep mining is conducted from cross measure adits driven in from the Cannop Valley. (1) Lower Limestone Shales; (2) Lower Dolomite; (3) Crease Limestone; (4) Whitehead Limestone; (5) Drybrook Sandstone; and (6) Dolomite of Drybrook Sandstone.

The iron in the Forest is found only

in two formations: the Drybrook Sandstone and the Carboniferous Limestone. The ore is hæmatite and excellent for the manufacture of steel. It is worked principally in two areas: (1) The northeastern district, and (2) The southwestern district.

1. The Northeastern District extends from Wigpool southwards past Cinderford to the Blackpool valley Coleford area in the north and (b) The Bream and Lydney area in the south.

(a) The Coleford area extends from Staunton in the north to Old Sling Pit in the south. The mining is largely confined to the limestone and is done by means of pits, the outcrop being exhausted. The New Dunn Pit (Pit = shaft) in this area produces

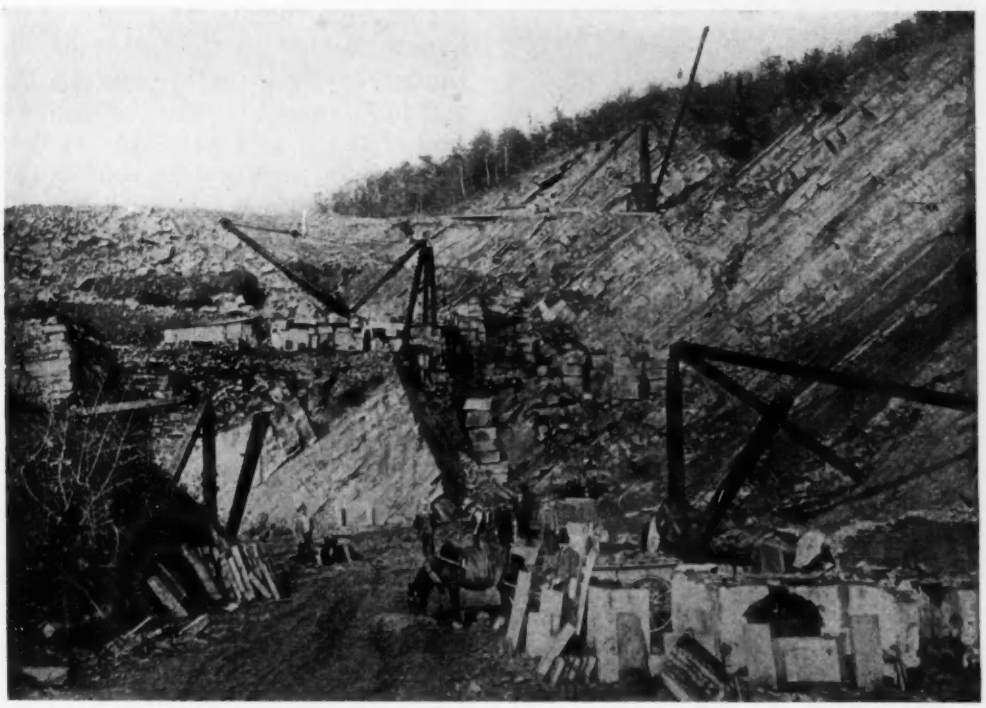


FIGURE 6.—Wilderness Quarry, showing steep dip in the strata on the east side of the Forest.

(Figs. 2 and 3). The iron here has been obtained from the Drybrook Sandstone. The outcrops are now exhausted and the deeper resources have been tapped. Cinderford dominates this district, and most of the iron mined in the east was smelted here until the furnaces were blown out in 1893; since then the bulk has been sent to Dowlais in South Wales.

2. The Southwestern District falls naturally into two divisions: (a) The half the total Forest production and the highest reserve is located here.

(b) In the Bream-Lydney area considerable quantities of ore have been won from the Drybrook Sandstone. Deep mining is conducted from cross measure adits driven from the Cannop Valley. (See section of Tuft's level, Fig. 5.)

The beds on the east of the Forest are deepest, for here the dip is

FIGURE 7.—Berry Hill, showing the level strata of the rocks in the west of the Forest.

steepest (Fig. 6). In one case, at Shakemantle Mine, the ore was worked to 900 feet below the outcrop. On the west side, where the dip is gentle, the ore fails at smaller depths; this gives economic importance to the dip of the strata here (Fig. 7). Red ochre, which finds a ready market as a coloring material, is obtained in considerable quantities at High Meadow near Coleford. In fact, Robin Hood Pit is worked principally for ochre, where it is associated with the limestones. It is also worked east of the Forest at St. Annals Pit, north of Cinderford.

For centuries the iron industry has been bound up with the timber of the Forest. The reason is obvious: until the eighteenth century iron was smelted with charcoal, which was easily obtained here. In Henry III's reign, about 1216, the iron works had grown too numerous and were a cause of great waste of timber in the Forest; for in that year "The Constable of St. Briavels is ordered to remove without delay all forges from the Forest of Dean except the King's demesne forges which belong to the Castle of St. Briavels and ought to be sustained with the trunks of old trees wherever they are found in the demesne of the Forest." In Elizabeth's reign the growing demand for a navy added to the value of the timber of the Forest. During the war in Charles I's reign the destruction of the woods was so great that the Forest reverted to the Crown at the request of the Foresters in 1670 after the restoration of Charles II.

FIGURE 8.—The Devil's Chapel, part of the "Scowles"—old Roman Iron Workings, located outside Bream where the Romans worked the iron at the surface in "day workings," in the Drybrook Sandstone.

### TIMBER

Sandstone is the soil most favorable to the oak, and this tree still prevails in the district. When timber was used for ships, the "kneed oaks" were in great demand. One of the finest remaining specimens of these is to be seen outside Newland, on the western edge of the Forest. In the seventeenth century the Forest supplied timber to the shipbuilding yards of Bristol, making that city one of the most important shipbuilding ports of the kingdom. The tendency now is for fir and spruce to replace the oak as the latter takes much longer to reach maturity. The chief markets are Gloucester and Stroud, where the oak is used in the wagon factories. The larches are used for pit props in the Forest collieries. Bark stripping and tanning were carried on until quite recently. There were numerous local tanneries, only one of which remains, at Newnham. Bark used to be sent down the Wye to Chepstow for export, but new methods of tanning have killed these industries.

FIGURE 9.—A rubbing of the brass of the heraldic crest of the Baynham family (date 1485) on the floor of Newland Parish Church, showing a miner with a mattock in his hand and a candle in his mouth, illustrating the fact that naked lights were used.

### COAL MINING

Coal mining was also carried on at an early date in this region. In the parish church of Newland on the western edge of the Forest, there is the brass of the heraldic crest of the Baynham family, depicting a miner, dated 1485. Forest records show that this family owned extensive coal reserves here at that date. Today, however, the little coal basin of the Forest of Dean is insignificant from the point of view of production, which has rarely exceeded one million tons per annum (1,239,108 statute tons in 1927). Whether the future will see any advance, it is impossible to say, but from the Coal Commissioner's latest report there is a reserve of only 260 million tons (cp. annual production of England and Wales for 1925: 243 million tons). Of the three series of coal seams, the first is unimportant, because of the inferior quality of the coal, and the thinness of the seams. These veins form the center of the plateau and may gain in importance as electricity is more widely used. The second or Middle Series consists of better quality house coal, but the greatest thickness of the seams is only 3 feet, 9 inches and the coal is exhausted at the outcrop. The third or lowest series of veins is the most

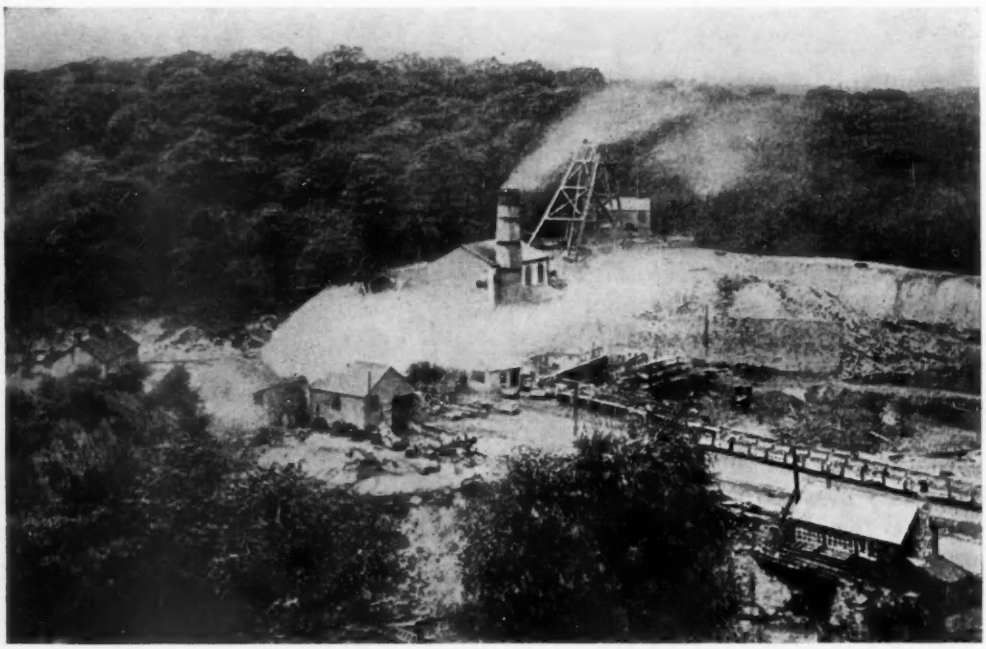


FIGURE 10.—Princess Royal Colliery, situated in the midst of beautiful scenery.

important. The thickest seam in the Forest—the Coleford High Delf—occurs here. This series is worked right round the Forest, and steam coal of excellent quality is obtained. These seams are thicker than those in the first two series, in some parts as much as 15 feet. There are two points of special interest in the mines of the Forest. First, they are free from fire damp. Gwinnell gives as his reason for the escape of the fire damp: "Thick porous sandstones overlie most of the coal seams, through which the carburetted hydrogen escapes instead of accumulating under pressure, as it does where impervious shales form the great mass of the coverings, as they do in many other coalfields." Whether the escape of the fire damp is due to this cause or to the numerous faults which cut up the rock, it is certain that as the fire damp escapes an enormous amount of water is admitted. In consequence of this, the drainage problem is very difficult, and in no other coal field of Great Britain are such powerful pumps required to raise the water. This difficulty has retarded the development of the coalfield, as the Free Miners[1] could not furnish the capital required to develop the deeper parts of the coalfield.

There are three types of coal mines in the Forest: those without power or machinery; the rather better

[1] According to a very ancient custom the mines of the Forest of Dean are leased only to *Free Miners*, that is to those who are born in the Hundred of St. Briavels, and have worked a year and a day in one of the Forest mines. It is supposed by some historians that this right to be a Free Miner was granted in the early part of the fourteenth century, for services rendered to the King in his battles with the Scots. To this day no one but a Free Miner can lease an iron mine, coal mine, or quarry in the Forest of Dean. In actual practice the law has been evaded, for Free Miners are allowed to sell their rights, and many companies have availed themselves of the fact to obtain control of the mines. There are now about 200 Free Miners, some of whom carry on their work by quite primitive methods.

equipped with a certain amount of power, and finally the modern colliery. Only in the northwest of the Forest can primitive workings of the first type still be seen. One example is found between Coleford and Hiller's Slade where the little bricked-in-mouth of the level with its rough wooden gate marks the entrance to the mine. The second type of colliery is to be seen in the Cannop Valley, where a level has been driven into the hillside at the "Norchard." Here, excellent house coal is obtained from the Coleford High Delf seam. The machinery worked by electricity is round the mouth of the level, it pumps the mine and raises the coal to the surface. Here, the visitor can walk down the slippery incline, roofed by shale and wooden beams, to the actual coal beds. The best type of colliery in the Forest is to be seen at the mine of the Cannop Colliery (Fig. 10). The deep coals of the Coleford High Delf are worked here. Modern machinery is used; there are turbine engines, and machinery for cutting and sorting the coal. The depth of this mine is not great; it is 630 feet below the surface and 150 feet below sea level. Most of the coal mined here is marketed in Bristol.

### STONE QUARRYING

Although coal is still the most important economic product of the Forest, during the last twenty years another industry has been developing so rapidly that it bids fair to outstrip coal mining; it is the quarrying of the sandstones of the coal measures, which lie between the middle and lower seams of coal. Until the practice of selling their rights became general among the Free Miners, there was little exploitation of the building stone. Now a Bristol company, the United Stone Firms, has acquired all the quarries of the district. The finest grey stone is obtained in the Cannop Valley, in three little "slades" (short steep valleys), leading down from the western plateau—Wimberry Slade being the best known. The beds vary in thickness, 6 feet is the average, though in parts

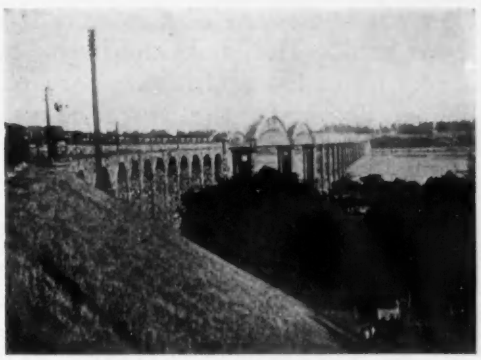


FIGURE 11.—The Severn Bridge, three miles above Lydney. This bridge is built of Forest Sandstone.

they are 10 or even 15 feet thick. Horse traction is essential owing to the steep gradients and sharp turns in the valleys. The stone is taken to the sawing and dressing works at Parkend and Bixlade. For building the Forest stone is excellent. Examples of its use can be seen in public buildings all over the country. In South Wales it is considered the best stone for resisting the moist smoky atmosphere of the Welsh valleys. Large quantities of the stone were used in the construction of the Severn Tunnel and the Severn Bridge (Fig. 11).

### DISTRIBUTION OF POPULATION

A comparison of the geological and population maps brings out clearly the connection between the mineral deposits and the concentra-

tion of human dwellings. The belt of comparatively dense population extending south from Cinderford to Upper Soudley originated in the working of the now-exhausted iron deposits, and is maintained by the coal measures exploited in more recent times (Fig. 12). Cinderford is placed on the slope of Edgehills away from the low lying brook and at the meeting place of many routes. The main concern of Cinderford is now coal. The tall chimneys of Crump Meadow and Lightmoor Collieries dominate the town. From them the little mineral lines carry the coal into the town, whence it is sent east to the Severn or west to Cannop Valley. The destination of either routes is the port of Lydney in the lower Cannop Valley. Cinderford is an extremely ugly town, but, like all places in the Forest, it has its "common" or "meend" (Welsh myndd-mountain). Commons in the Forest, onto which the villagers turn a motley crowd of sheep, pigs, and fowls are usually on the higher land above the village. Cinderford Meend is not typical in its position, as it lies low, near the stream. It was evidently the scene of early iron workings, as cinder mounds, covered with grass, are scattered over it. It is significant of the barrier character of the eastern hills of the Forest that no railway line crosses the ridge. A motor service has been established between Newnham and Cinderford, but it passes down the Soudley Valley before turning east to the Severn.

Coleford resembles Cinderford in some respects; its importance is based on mining, originally iron, now coal. Coleford stands on the western threshold of the Forest, but whereas Cinderford is a long *line*

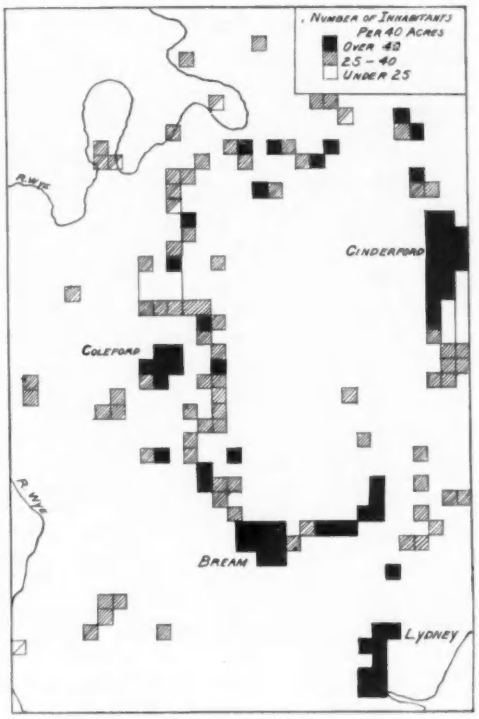



FIGURE 12.—Distribution of population in the Forest of Dean area. By comparing this map with the geological map (Fig. 3), it will be seen that the population is densest where the iron and coal deposits occur close together at Cinderford, Coleford, and Bream. Lydney is an exception, but this town is the port of the Forest on which the important routes converge.

of population, Coleford is a *star;* this contrast reflects the difference in structure of the east and west of the Forest. Routes radiate in all directions from Coleford. To the south lies the Milkwall district with Easter Iron Mine, and disused steel works and clay pits. Eastward is a line of coal pits, all disused, while to the west the Scowles show the remains of Roman iron workings but no modern shafts. The ordnance map gives the main railway routes from Coleford: southeastward through Parkend to Lydney, and westward to Monmouth across the Wye. South of Coleford the line of population marked by the villages from Milkwall

to Bream shows how closely it is related to the industry of the district. The line crosses the Cannop Valley from Bream and runs northeastward to Yorkley and on to Cinderford. There is a thinning out of the population in the north, which may be explained by the fact that the coal outcrop is almost exhausted here; in addition to this the altitude may account for the sparseness of the population.

Lydney (the island of the Lydd—old name for the Cannop Brook), as its name implies, originated on a hill rising from the marshes at the mouth of the river. It stands where the most important Forest route meets the great roadway from Gloucester to South Wales. A few miles higher up, the Severn Valley narrows and is spanned by a fine bridge (Fig. 11). The Severn and Wye and Severn Bridge Railway passes down the Cannop Valley to Lydney and thence across the bridge to join the Gloucester-Bristol line. Although Lydney is the meeting place of the chief roads and railways of the forest district, there is no direct railway route from Lydney to the Wye Valley; hence, the hinterland of this little port coincides with, and does not reach beyond the area of the Forest. Lydney can never be a large port because the Cannop is only a small stream and the nature of the River Severn at this point makes it impossible for a large port to be maintained on this side of the river. The Cannop has, however, been canalized to a depth of 14 feet, as far as the first bridge. Along the left bank of the Cannop the railway lines pass to Lydney Docks, where the coal trucks are emptied of their contents. It is difficult to obtain detailed information about the distribution of coal by water, but the figures supplied by the Harbour Master of Lydney show that about one-third of the total production of the coalfield is carried by water. Before the war it was taken as far as France and Ireland, but the greater part of the house coal now goes to the coasts of North Devon and Somerset, while the steam coal is sent to Bristol.

In addition to being a port, Lydney has industries of its own. The chief of these is the manufacture of tin plate. The red ochre obtained at High Meadow mines is made into color wash and paint in the town, and there are also cement and brick works based on the alluvial clays and gravels of the river. Lydney is thus the southern projection of the forest land and the gateway through which the Forest District communicates with the outside world, and is linked with the great routes along the Severn and the Bristol Channel.

The main rail routes of the Forest have been indicated, but the chief roads deserve mention, as most of the metalled roads shown on the ordnance map were Roman Ways. This is not surprising when we remember the large scale on which the Romans worked the iron of the Forest. There are remains of Roman pavements at many places, *e.g.* near Lydney—a Roman road passed from Gloucester (Glevum) through Lydney and on to Caerwent. Another passed from Monmouth (Blestium) to Gloucester through Staunton (Stane Town or Town on the Stone Street), where remains of pavements can be seen and vestiges of considerable entrenchments in the vicinity of the church.

After making a study of the eco-

nomic development of a region as a result of the natural surroundings, the geographer naturally asks, "What of the Future?" The industrial outlook of the Forest is not bright. The only suggested remedy for the dwindling of its industries lies in a colossal undertaking which, so far, has only reached the project stage. The Severn Barrage Scheme, for harnessing the tides of the lower Severn, if carried through, may inaugurate a new period of industrial activity. In the widespread results claimed by the advocates of this scheme, one of the beneficiary districts specially mentioned by the British Board of Trade experts is that of "the Basin of the Severn and the Forest of Dean."

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*(Due to lack of space, the Book Reviews are omitted in this issue.)*

## ANNOUNCEMENT

THE series on the *Agricultural Regions of Australia*, by Dr. Griffith Taylor, is completed in this issue and Dr. O. E. Baker contributes another instalment of his *Agricultural Regions of North America*.

Dr. Samuel Van Valkenburg of the College of the City of Detroit will begin his series on the *Agricultural Regions of Asia* in the October issue. This will be followed by *Agricultural Regions of Africa* by Homer L. Shantz, President of the University of Arizona, and will complete the finest geographic discussion of the world's agriculture thus far published.

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